WL-TR-96-8034

NATIONAL HOTLINE EXPANSION

Roy W. Hardy

Edison Materials Technology Center (EMTEC)
3171 Research Blvd.
Kettering, OH 45420

September 1995

Final Report For the Period 01 September 1993 - 30 September 1995

Approved for Public Release; Distribution is Unlimited.

Manufacturing Technology Directorate
Wright Laboratory
Air Force Materiel Command
Wright-Patterson Air Force Base, Ohio 45433-7739

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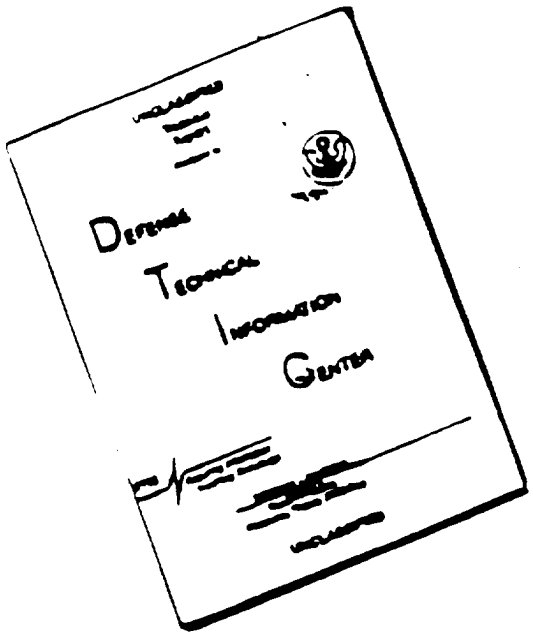

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This report has been reviewed by the Office of Public Affairs (ASC/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

RAFAEL REED
Project Engineer
Metals Branch
Processing & Fabrication Division

STEPHEN THOMPSON
Chief
Metals Branch
Processing & Fabrication Division

BRUCE A. RASMUSSEN, Chief
Processing & Fabrication Division
Manufacturing Technology Directorate

"If your address has changed, if you wish to be removed from our mailing list, or if the addressee is no longer employed by your organization please notify WL/MTPM, Bldg. 653, 2977 P St., Suite 6, W-PAFB, OH 45433-7739 to help us maintain a current mailing list."

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13. ABSTRACT
The Heat Treating Network's HOTLINE was developed in response to the immediate technical needs of commercial heat treaters and users of heat treating. The original HOTLINE was a regional (state of Ohio) communications network. The HOTLINE's purpose is to provide responsive (real time) solutions to short term problems. Specifically, problems which can primarily be solved without requiring face-to-face interaction. This includes names of suppliers, contacts for parts and services, and other customer needs. This project expanded the existing HOTLINE into a National Hotline Information Center. It includes computer hardware and software upgrades, and also includes marketing efforts to promote this service to the metalworking industry. The goal was to make the HOTLINE the recognized focal point for solving problems and addressing the technology needs of the field of heat treating for the metalworking industry in the United States.

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CONTENTS

1.0 Foreword

The Heat Treating Network (HTN) HOTLINE required the TRP award to develop the procedure and infrastructure to meet anticipated demand of a national hotline and maintain a high level of quality service to clients. This was to be accomplished through the following objectives:

1.1 Develop people and procedures which will effectively serve customer expectations with timely information.

1.2 Develop the infrastructure (communications and computers) to efficiently serve customer expectations.

1.3 Develop and track measurements to justify the HOTLINE's productive work results.

2.0 Summary

In order to take a regional information source for heat treating and expand it to a national information center, all of the stated objectives were met. The staff of HTN have been trained and procedures have been developed to answer callers requests for assistance in a timely manner. Sufficient computer hardware and software have been purchased to facilitate the information center. A system to measure the effectiveness of hte Hotline has been developed as well as a means of desiminating the information to the metalworking industry at large.

3.0 Introduction

The Heat Treating Network's HOTLINE was developed in response to the immediate technical needs of commercial heat treaters and users of heat treating. The original HOTLINE was a regional (state of Ohio) communications network. The HOTLINE's purpose is to provide responsive (real time) solutions to short term problems. Specifically, problems which can primarily be solved without requiring face to face interaction. This may include names of suppliers, contacts for parts and services and other customer needs. This project expanded the existing HOTLINE into a National Hotline Information Center. It includes computer hardware and software upgrades, and also includes marketing efforts to promote this service to the metalworking industry. The goal was to make the HOTLINE the recognized focal point for solving problems and addressing the technology needs of the field of heat treating for the metalworking industry in the United States.

4.0 Methods, Assumptions, and Procedures

4.1 TASK	TASK HEADING
4.1.1	Start up plan (This includes development of sales and marketing plan, operations plan, computer specifications, and technical resource plan.
4.1.2	Assembly and installation of HOTLINE TIES system.
4.1.3	Marketing and Dissemination of HOTLINE in print, and electronic media.
4.1.4	HOTLINE system testing and operation.
4.1.5	Full Scale Technology Deployment.
4.1.6	Reporting

4.2 HOTLINE TASK SCHEDULE

Task	Subtask	Weeks After Contract Start
. Start up		1-10
	a) Establish goals and measurements	**completed**
	b) Complete operations plan: policies, procedures (operations, cost, time, materials, resources, return policies, warranty)	**completed**
	c) Establish computer specifications (database, resource, and hotline tracking).	**completed**
	d) Establish communication specs (phone, modems)	**completed**
	e) Establish marketing plan	**completed**
	f) Establish sales plan	**completed**
	g) Establish technical resource plan.	**completed**
	h) Hire human resources (If necessary)	**completed**
	I) HTN Survey	**completed**
. Assembly and installation of Hotline system		8-40
	a) Select & purchase reference materials	**completed**
	b) Select & purchase computer system	**completed**
	c) Select and purchase communication system	**completed**
	d) Recruit Technical, Information, Economic Resources	**completed**
	e) Train personnel about computer and communication systems	**completed**
	f) Debug and preliminary test of Hotline elements (facilitator, resources, communication linkages, database and follow up)	**completed**
	g) Perform pilot run of Hotline system	**completed**
. Marketing & dissemination		20-52
	a) Review-revise marketing plan	**completed**
	b) Develop sales strategy (sell by phone, personal contact, word of mouth, organizations)	**completed**
	c) Develop cost data and pricing strategy (sell by call, monthly subscription, block of calls, free initial Hotline, discounts, etc.)	**completed**
	d) Select and contact marketing sources (magazines, videos, TV, Radio interviews, newspapers)	**completed**

Task	Subtask	Weeks After Contract Start
	e) Measure market budget to returns	**completed**
	f) Gain publicity through conferences and papers	**completed**
. Hotline launch and operation		30-52
	a) Gather data for measurement of operation (monitor calls, use feedback cards to compare operation plan to reality)	**completed**
	b) Trouble shooting-streamlining Hotline system	**completed**
	c) Explore use of computer bulletin boards	**completed**
	d) Prepare for project self sufficiency	**completed**
	e) Reevaluate human resources to quality of service	**completed**
. Outreach		40-52
	a) Start using the new TIES system to address Hotline calls	**completed**
	b) Test tracking and measurement systems	**completed**
	c) Promote HTN Hotline	**completed**
	d) Debug and Troubleshoot System	**completed**
. Reporting		
	a) Budget to cost analysis	4,8,12,16,20,24,28,32,36,40,44,48,52
	b) Federal technical report generation	Quarterly
	c) Federal financial report generation	Quarterly
	d) Annual financial audit	52

5.0 Results and Discussion

5.1 Progress and Plans

As previously reported, HTN has successfully completed the start up task (3.1) with the exception of hiring additional personnel. Hiring of additional personnel will be postponed until needed. At this point, the valuable "in-kind" assistance of the HTN membership coupled with the expertise of HTN's staff is meeting all requirements of the users. The survey of all of the users of the HOTLINE is ongoing and as previously reported, a survey of each service is sent out at the completion of each HOTLINE request. To date, the response to these surveys have been favorable (see attached Appendix A). These surveys will determine the effectiveness of the HOTLINE in answering the needs of the users and will give HTN the information needed to make any adjustments to the service to meet these needs.

As previously reported, HTN has selected, purchased, and upgraded the computer system to be used in the T.I.E.S. system (3.2). Evaluation, purchase, and installation of the needed software has been completed. The communications equipment have been upgraded and an Internet address has been established. To afford the ability of accessing the system while off site, a lap top computer has been purchased as well as the software Norton's PC Anywhere. Additionally, a color scanner was purchased to enable electronic filing of the answer to a request, which may include metallurgical photomicrographs.

The linkage between the software TELEMAGIC and HTN's 9,000 name database and the training of HTN staff has been completed. Incoming HOTLINE requests are now entered into a TELEMAGIC data base at the time of contact and a Verification form (See Attached Appendix B) is faxed within minutes of the initial contact to not only verify the problem statement but to also act as a disclaimer. After completion of the HOTLINE request a Request for Help form is faxed to the user of the service (See Attached Appendix C), a Service Questionnaire form is faxed from TELEMAGIC to determine the level of satisfaction of the service (See Attached Appendix D) as well as inform the first time user that there will be a charge for any additional requests.

The marketing of the HOTLINE (3.3) continues in the heat treating industry's two primary trade journals, *Metal Heat Treating* and *Industrial Heating.*(See Attached Appendix E) Beginning in the fall of 1995 advertisements will be placed in *Manufacturing Engineering* and *Modern Machine Shop,* both well read and respected trade journals in the field of machining. These advertisements will be run and monitored for their effectiveness in reaching the target market of heat treating users on a national level.

5.2 New Services and Changes in Operation

An improvement and change to the operation (3.4) is the addition of a scanner which will enable HTN to minimize the need for "paper" files in maintaining the HOTLINE as well as make accessing the historic information more efficient. In addition, a system for capturing the information contributed by HTN members to requests is being developed. Currently, follow up phone calls to those participating members are made and the information is verbally communicated, then entered into TELEMAGIC. The new procedure will be a request for reporting faxed from TELEMAGIC and then scanned into the request file when returned from the participating member.

Additionally, HTN's HOTLINE will leverage our proficiency by cooperating with ASM-Heat Treating Society in developing a heat treating answers bulletin board. ASM has an existing bulletin board and HTN will supply the expertise, through the HOTLINE system, which will be a further technology deployment to the heat treating industry.

5.3 New Activities, Accomplishments, or Developments:

Technology deployment (3.5) continues through Executive Summaries to HTN members (See Attached Appendix F) as well as publishing of selected Technical HOTLINE requests in the technical trade journal *Metal Heat Treating* (See Attached Appendix G). In addition, HTN will continue to revise and enhance the reporting documentation generated by TELEMAGIC. These activities will be ongoing throughout the life of this program.

6.0 Conclusions

Based upon the deliverables stated in the original proposal and the Statement of Work, the contractor has successfully performed and completed all of the tasks outlined below:

6.1 Developed and provided an advanced procedure using T.I.E.S. method to effectively receive, screen, address, and track HOTLINE requests on a national level. It has been developed to cover up to 25 calls per month.

6.2 Provided communication and computer based infrastructure to efficiently track and store data, retrieve information and disseminate the necessary files and reports critical to justifying the HOTLINE service.

6.3 Record, track and measure the performance of the HOTLINE by Technical, Informational, or Economic problem types in addition to demographics of the callers. (See Attached Appendix H)

6.4 Provided technical reports to comply with Federal and State reporting requirements.

6.5 Provided the necessary training to HOTLINE facilitators for successful operation of the T.I.E.S. system, as well as the efficient use of the communication and computer based infrastructure.

6.6 Demonstrated to the Technical Project Manger through tests and actual real time operation a successful model to receive, screen, address and track HOTLINE requests.

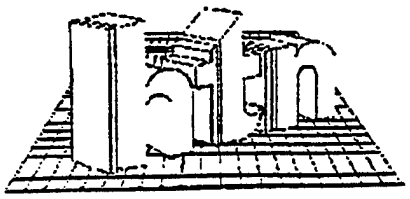
6.7 Provided papers and articles for technology deployment, and publicity purposes. (See Attached Appendix G)

6.8 Justified through measurements the value of the National HOTLINE to the heat treating industry and its customers. (See Attached Appendix I)

APPENDIX A

SERVICE QUESTIONNAIRES RECEIVED

IITL #252



Heat Treating Network
6600 W. Sprague Road, #445
Cleveland, Ohio 44130-6318
216-243-8990 1-800-736-7195
FAX (216) 243-8992

Attn: Sandy Cioletti

DATE	**August 29, 1995**
CONTACT	**Andrew Millner**
TITLE	
COMPANY	**MECA ELECTRONICS**
ADDRESS	**459 East Main Street**
CITY/STATE/ZIP	**Benville, NJ, 07834**
FAX	**(201) 625-1258**

Thank you for taking advantage of the **FREE* HOTLINE request for help call offer. We appreciate the opportunity to assist you with your heat treating problems and to promote the industry by sharing valuable information and new developments.

In order to continue offering relevant heat treating advice in a timely manner, we ask that you take a moment to complete the short questionnaire regarding this service. Your input will help us gage our performance and see to the needs of our customers.

HOTLINE SERVICE QUESTIONNAIRE

- Was the information you received pertinent to your request? Yes ✓ No ____
- Was the response turn-around timely? Yes ✓ No ____
- What would you estimate the *$ value* of the answer you received?

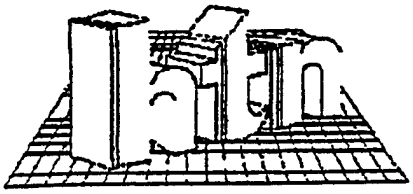
  <$500 ____ <$1.000 ✓ <$5,000 ____ >$5,000 ____

- Would you use the HOTLINE again? Yes ✓ No ____
- Would you recommend the HOTLINE to others? Yes ✓ No ____
- Comments: _____

  Change the city name from Benville to Denville

**A minimum fee of $50.00 will be charged to non-HTN members for future HOTLINE request for help calls. HTN Members are not subject to this minimum fee and are entitled to unlimited use of the HOTLINE service. A quote will be provided to non-members and members for requests that require extensive research and time.*

Completed questionnaires may be faxed to Sandy Cioletti of HTN at 216-243-8992.



HTL #256

Heat Treating Network
16600 W. Sprague Road, #275
Cleveland, Ohio 44130-6318
216-243-8990 1-800-736-7195
FAX (216) 243-8992

DATE	**August 29, 1995**
CONTACT	**John King**
TITLE	
COMPANY	**Rivnut Engineering Products**
ADDRESS	**2705 Marion Drive**
CITY/STATE/ZIP	**Kendalville, IN, 46755**
FAX	**(219) 347-3926**

Thank you for taking advantage of the *FREE HOTLINE request for help call offer. We appreciate the opportunity to assist you with your heat treating problems and to promote the industry by sharing valuable information and new developments.

In order to continue offering relevant heat treating advice in a timely manner, we ask that you take a moment to complete the short questionnaire regarding this service. Your input will help us gage our performance and see to the needs of our customers.

HOTLINE SERVICE QUESTIONNAIRE

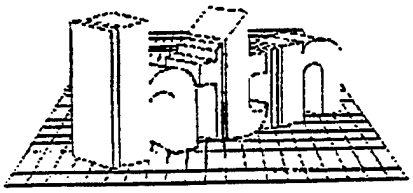
- Was the information you received pertinent to your request? Yes X No ____
- Was the response turn-around timely? Yes X No ____
- What would you estimate the *$ value* of the answer you received?

  <$500 X <$1,000 ____ <$5,000 ____ >$5,000 ____

- Would you use the HOTLINE again? Yes X No ____
- Would you recommend the HOTLINE to others? Yes X No ____
- Comments: Excellent service!

*A minimum fee of $50.00 will be charged to non-HTN members for future HOTLINE request for help calls. HTN

HTL #251



Heat Treating Network
6600 W. Sprague Road, #445
Cleveland, Ohio 44130-6318
216-243-8990 1-800-736-7195
FAX (216) 243-8992

DATE	August 29, 1995
CONTACT	Joe Cerny
TITLE	
COMPANY	CENTERIOR ENERGY
ADDRESS	4141 Rockside Road
	4th Floor
CITY/STATE/ZIP	Seven Hills, OH, 44131
FAX	(216) 520-9565

Thank you for taking advantage of the *FREE HOTLINE request for help call offer. We appreciate the opportunity to assist you with your heat treating problems and to promote the industry by sharing valuable information and new developments.

In order to continue offering relevant heat treating advice in a timely manner, we ask that you take a moment to complete the short questionnaire regarding this service. Your input will help us gage our performance and see to the needs of our customers.

HOTLINE SERVICE QUESTIONNAIRE

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- Was the response turn-around timely? Yes ✓ No ____
- What would you estimate the *$ value* of the answer you received?

  <$500 ✓ <$1,000 ____ <$5,000 ____ >$5,000 ____

- Would you use the HOTLINE again? Yes ✓ No ____
- Would you recommend the HOTLINE to others? Yes ✓ No ____
- Comments: YOUR RESPONSE WAS GREAT. APPLICATION FOR JOINING HTN HAS BEEN SUBMITTED TO CORP. FOR APPROVAL.

**A minimum fee of $50.00 will be charged to non-HTN members for future HOTLINE request for help calls. HTN Members are not subject to this minimum fee and are entitled to unlimited use of the HOTLINE service. A quote will be provided to non-members and members for requests that require extensive research and time.*

Completed questionnaires may be faxed to Sandy Cioletti of HTN at 216-243-8992.

FAX TRANSMISSION COVER SHEET

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FOR ALL YOUR MAGNETIC SHIELDING NEEDS

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- Shielded enclosures for Video Display Terminals
- In-house engineering, design, heat treat and test facilities
- Site survey, consulting, and installation services for area shielding
- Sheet and foil materials from stock

SENT TO: HTN / Roy Hardy

SENT FROM: Dan Walsh

FAX NO: 216-243-8992

DATE: 8/4/95

SUBJECT:

NO. of Pages (including cover sheet) 2

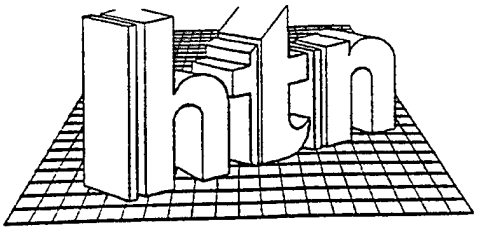
Roy: Many, Many Thanks! You've saved me a lot of time + energy. Faxed my needs to Mrs Lewis + he has already quoted us. A job well done. Thanks Again! Reading your magazine really paid off.

Sincerely,

D. J. Walsh

APPENDIX B

HOTLINE VERIFICATION FORM



HEAT TREATING NETWORK
16600 W. Sprague Road #445
Cleveland, OH 44130-6318
216-243-8990 FAX: 216-243-8992
1-800-736-7195

VERIFICATION OF HOTLINE REQUEST INFORMATION

DATE	DATE
HTL#	FIELD(LVL3_RFH_Number)
COMPANY	FIELD(LVL1_Company)
CONTACT	FIELD(LVL2_Name)
TITLE	FIELD(LVL2_Source)
ADDRESS	FIELD(LVL1_Address)
	FIELD(LVL1_Nd_line)
CITY/STATE/ZIP	FIELD(LVL1_City), FIELD(LVL1_State), FIELD(LVL1_Zip)
PHONE	FIELD(LVL1_Work_phone)
FAX	FIELD(LVL1_Fax_Number)

ROBLEM STATEMENT

IELD(LVL3_Background_Problem)

OST FIELD(LVL3_RFH_Cost)

o ensure accurate processing of your HOTLINE request, please review the above information, sign and return this form to Heat reating Network via fax (216-243-8992).

SIGNATURE _____ DATE _____

DISCLAIMER

he Heat Treating Network, Inc. is a not for profit organization that specializes in the technology transfer f heat treating information. **HTN MAKES NO IMPLIED OR EXPRESSED WARRANTIES OF ANY KIND EGARDING THE INFORMATION GIVEN.** HTN is not liable for any situation that may arise from the dvice or information offered to the client. The "answers" given to the client are suggestions and should ot be construed as definite resolutions.

APPENDIX C

HOTLINE REQUEST FOR HELP FORM

Date: DATE

HTN Request for Help (RFH)
RFH Number: FIELD(LVL3_RFH_Number)

Contact Date: FIELD(LVL2_Start)
Company: FIELD(LVL1_Company)
Address: FIELD(LVL1_Address)
FIELD(LVL1_Nd_line)
FIELD(LVL1_City), FIELD(LVL1_State), FIELD(LVL1_Zip)
Contact: FIELD(LVL2_Name)
Phone: FIELD(LVL1_Work_phone) FAX: FIELD(LVL1_Fax_Number)

BACKGROUND/PROBLEM STATEMENT

FIELD(LVL3_Background_Problem)

ACTION TAKEN

FIELD(LVL3_Action)

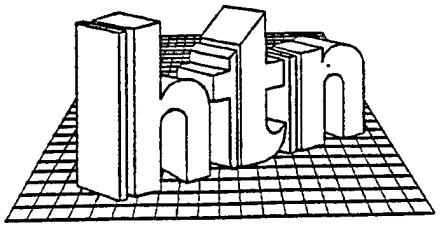
RETURN OR PAYOFF

FIELD(LVL3_Return_or_Payoff)

APPENDIX D

HOTLINE SERVICE QUESTIONNAIRE

HTL #FIELD(LVL3_RFH_Number)



Heat Treating Network
16600 W. Sprague Road, #445
Cleveland, Ohio 44130-6318
216-243-8990 1-800-736-7195
FAX (216) 243-8992

DATE	DATE
CONTACT	FIELD(LVL2_Name)
TITLE	FIELD(LVL2_Source)
COMPANY	FIELD(LVL1_Company)
ADDRESS	FIELD(LVL1_Address)
	FIELD(LVL1_Nd_line)
CITY/STATE/ZIP	FIELD(LVL1_City), FIELD(LVL1_State), FIELD(LVL1_Zip)
FAX	FIELD(LVL1_Fax_Number)

Thank you for taking advantage of the **FREE* HOTLINE request for help call offer. We appreciate the opportunity to assist you with your heat treating problems and to promote the industry by sharing valuable information and new developments.

In order to continue offering relevant heat treating advice in a timely manner, we ask that you take a moment to complete the short questionnaire regarding this service. Your input will help us gage our performance and see to the needs of our customers.

HOTLINE SERVICE QUESTIONNAIRE

- Was the information you received pertinent to your request? Yes _____ No _____
- Was the response turn-around timely? Yes _____ No _____
- What would you estimate the *$ value* of the answer you received?

  <$500 _____ <$1,000 _____ <$5,000 _____ >$5,000_____

- Would you use the HOTLINE again? Yes _____ No _____
- Would you recommend the HOTLINE to others? Yes _____ No _____
- Comments: _____

_____

**A minimum fee of $50.00 will be charged to non-HTN members for future HOTLINE request for help calls. HTN Members are not subject to this minimum fee and are entitled to unlimited use of the HOTLINE service . A quote will be provided to non-members and members for requests that require extensive research and time.*

Completed questionnaires may be faxed to Sandy Cioletti of HTN at 216-243-8992.

APPENDIX E

HOTLINE ADVERTISEMENTS

Membership Has its Rewards.

As a member of the Heat Treating Network you receive a host of services and opportunities to give you the competitive edge in today's business world. Membership has many rewards including:

Hotline Access.
Join the hundreds of other Hotline members in North America's premiere communications network which provides information, solutions and referrals to providers of heat treating services such as:

- Captive heat treaters
- Commercial heat treaters
- Machine/furnace builders
- Distributors of equipment
- End users of heat treating parts

Industry-Focused Seminars.
Members enjoy discounted registration fees for ongoing workshops and seminars instructed by experienced heat treaters. It's just another way membership has its rewards.

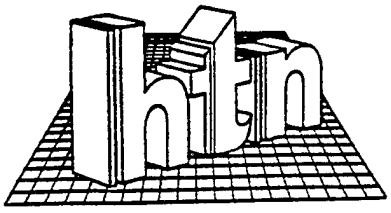
Membership Referrals.
New business opportunities, exposure to new customers and the opportunity to expand your market base are just a few examples of how HTN members have benefited from our referral network. By putting members in touch with each other everyone benefits.

Apprenticeship Program.
HTN and its members are working to replenish the pool of qualified heat treaters. Comprehensive efforts are being taken to develop the forthcoming apprenticeship program to be industry recognized and approved by the appropriate government agency. More details will be available soon.

Involvement in Cutting Edge Technologies.
By pooling our members resources and knowledge all members can stay abreast of changing and developing technologies. Technologies such as, Fuel Efficiency Programs, Laser-to-Monitor Furnace Atmospheres, Heat Up and Soak Times, and Distortion Control to name a few.

Group Discounts and Savings.
Discounts are now available to members through bulk gas agreements and our Ohio members are eligible to participate in our Worker's Compensation Group Rating Plan. Your savings can be substantial!

Call 1-800-736-7195



Heat Treating Network
16600 W. Sprague Road, Suite 445
Cleveland, Ohio 44130

☐ **YES!** please send me more information on the Heat Treating Network.

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Phone _____

Circle 92

Drop Us A Line...

CC/ZIRCOA · AGA GAS, INC. · AKRON STEEL TREATING CO.
LIQUIDE AMERICA · AMERICAN GAS ASSN. LAB · AMERICAN
AT TREATING, INC. · ARGO-TECH CORP. · ATMOSPHERE
NEALING, INC. · ATMOSPHERE PROCESSING, INC. · CINCIN
TI FLAME HARDENING · CLEVELAND ELECTRIC LABS · EVE
ND FLAME HARDENING · CONFORMA CLAD · DEFORMATION
ONTROL TECHNOLOGY · DETROIT FLAME HARDENING · AS
HIO GAS COMPANY · ERIE STEEL TREATING, INC. · EUCLI EA
EATING CO. · GENERAL METAL HEAT TREATING · HEAT TRI ING
C. · HINDERLITER HEAT TREATING, INC. · HI TECMETAL GI JP
NCINNATI STEEL TREATING CO. · CONRAD KACSIK INSTR EN
STEMS · LINDBERG HEAT TREATING CO. · LIQUID CARBC C IN
STRIES · MARATHON MONITORS · METALLURGICAL PR ESS
G, INC. · METAL TREATING, INC. · PETERS' HEAT TREATING C.
LEM AUTOMATION · SHORE METAL TECHNOLOGY, INC SO
R ATMOSPHERES, INC. · SOUTHEASTERN HEAT TREA G
NAXOL, INC. · THERMAL TREATMENT CENTER, INC. · TC CO
C. · WINSTON HEAT TREATING, INC. · UNIVERSAL I OD

...These Members Did

Call 1-800-736-7195

htn

Heat Treating Network
16600 W. Sprague Road
Suite 445
Cleveland, Ohio 44130

Circle #35

Why Make Heat Treating Problems Hard?

"When I quench my parts, made of 4150 steel, they crack...."

"My furnace heating elements use to last 2 years, now they fail after six months..."

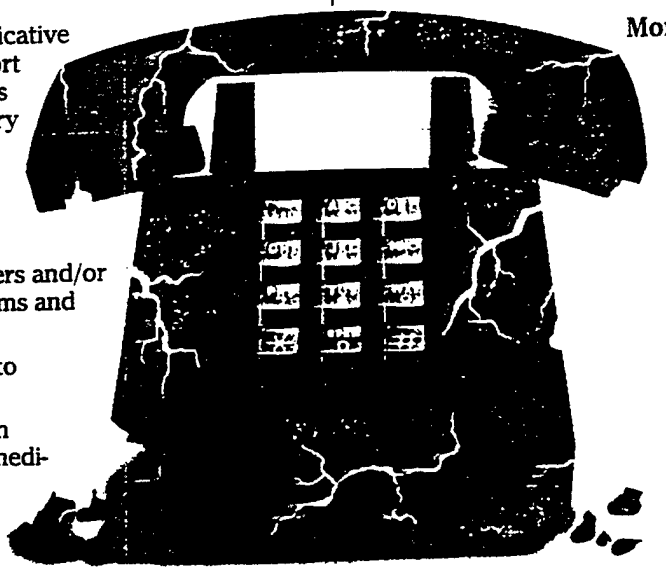
Hard questions. The solution is a crack. Call the Heat Treating Network to solve your heat treating problems in a snap. HTN is an independent, not-for-profit, national association of heat-treating companies, suppliers, technical centers and universities dedicated to ensuring the competitiveness and continued success of the nation's heat treating industry.

HTN Resources.

- Knowledgeable and experienced staff
- Active participation with research labs, technical centers, universities and consulting firms.
- Our member resource pool combined has hundred of years worth of heat treating experience and knowledge

The Hotline.

- Provides a communicative and technical support link with the nation's heat treating industry
- An unbiased source of heat treating information
- Provides technical, informational answers and/or resources to problems and requests
- Timely turnaround to requests
- Developed in 1990 in response to the immediate technical needs of commercial heat treaters



More HTN Benefits.

- Membership referrals
- Opportunity to participate in apprenticeship program
- Industry-focused seminars and workshops
- Group discounts and savings
- Involvement in cutting edge technologies

Call Today to Receive Your Free HOTLINE request for help.

1-800-736-7195

Heat Treating Network
16600 W. Sprague Road, Suite 445
Cleveland, Ohio 44130

☐ **YES!** I have some hard problems to crack. Please send me more information on the Heat Treating Network.

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Phone _____

E-4

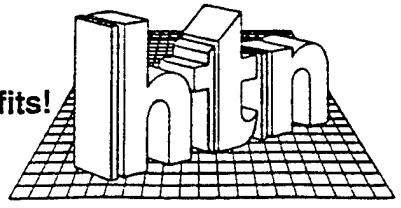
Circle # 36

Heat Treaters Expect Results
The Heat Treating Network Delivers

Highly recognized for its heat treating technology transfer commitment and the expertise of its network providers, HTN is leading its members into the future. During the past seven years, HTN built an organization that creates programs and projects in response to the changing needs of the heat treating industry. Here's how an HTN membership can turn needs into benefits:

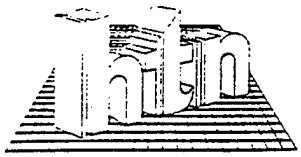
Requests	Responses	Benefits
"Teach our trade"	Apprenticeship Program– created to prepare your existing and future employees in becoming skilled heat treaters.	$42,000 investment from both industry and outside foundations
"Provide more heat treat training"	HTN will design an on-site training program tailored to meet your specific needs.	$500 savings per day over other sources
"Give us a program that provides solutions to our technical problems"	HOTLINE– formed in 1991 to address short-term heat treat problems. Members have unlimited access to service. In 1994 expansion into a National Information Center.	$2,000 average savings per call– $250,000 in new investments for extended service
"Help us implement a quality system"	ISO 9000– coordinated a comprehensive training and consulting program to help members gain certification.	$7,000 savings off preaudit over other ISO 9000 programs
"Find us an effective route to meet EPA requirements"	HTN formed a technology alliance with Los Alamos National Laboratory's Small Business Initiative to assist heat treaters with environmental issues.	$183,000 project critical to existance of heat treaters
"Conduct applied research projects"	Core Technology Program– implemented in 1991 to provide member companies an advantage by pooling resources to gain the latest in technology. Heat Up and Soak Times, Distortion Control and Nitriding of Tools and Dies projects are in progress. Members own the results of the projects.	$12,500/ member ownership share– this results in short return on investment to participating companies

When it comes to choosing a professional organization, choose the *proven* leader in leveraging resources into benefits!
Put the Power of the Network to work for you today!
Call HTN now at 1-800-736-7195.



APPENDIX F

HOTLINE EXECUTIVE SUMMARIES



Quarterly Executive Summary of Hotline Activities

Here is a summary of Hotline calls received from January 1995 through March 1995:

- Total calls ⇨ 42
- Calls from members ⇨ 13
- Technical calls ⇨ 13
- Informational calls ⇨ 22
- Economical ⇨ 7
- Referral to member ⇨ 8
- Total economic impact ⇨ $ 765,500

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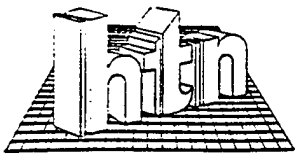


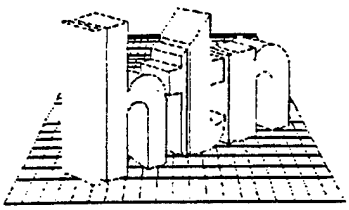
Quarterly Executive Summary of Hotline Activities

In the first quarter of calender year 1995 (HTN 3rd quarter Fiscal year 1995) we received numerous Hotline calls which we have categorized depending on the nature of the Request For Help (RFH). Twenty nine of the calls received were from non-members and we received a total of forty two RFHs. The total estimated economic impact (savings/avoidance/additional business) of these calls was $ 765,500. The specific breakdown of the requests taken were thirteen technical, twenty two informational, and seven economic. The technical and informational often involve a business referral which HTN always directs toward members with the necessary capabilities when possible with a look at proximity to the client. Referrals of this kind totaled eight..

Several technical calls have been adapted into articles for *Metal Heat Treating*'s HTN HOTLINE section. These include:

- H-158 Distortion of 86B30 During Quenching
- H-160 Nickel Plating of Nitrided Surface Causing Surface Cracks
- H-163 Low Surface Hardness on Carbonitrided 12L14
- H-167 Alternatives to Lead Quenching of Tool Steels
- H-168 Information on 1144 Steel, Coarse Grain Structure
- H-178 Fish Eye Inclusion Failure
- H-186 RDS Tool Steel Shaft Cracking after Heat Treating
- H-187 Carbon Pick-up on 410 Stainless Steel

A complete log of each call and its description is being kept, and ultimately inserted into the database. The log is being made available to all members and upon request a detailed report can be forwarded.



Quarterly Executive Summary of Hotline Activities

Here is a summary of Hotline calls received from April 1995 through June 1995:

- Total calls ⇨ 38
- Calls from members ⇨ 8
- Technical calls ⇨ 20
- Informational calls ⇨ 20
- Economical ⇨ 0
- Referral to member ⇨ 9
- Total economic impact ⇨ $ 301,500

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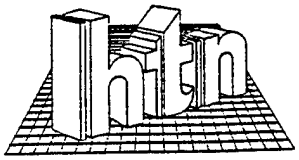
HOTLINE NUMBER LIST



Heat Treating Network

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-118 M T	Vacuum Quench of 4140	7/19/94	8/1/94	5000
H-119 NM I	Distortion of 8620	7/21/94	7/25/94	500
H-120 NM RM,E	Tufftride Source	7/24/94	8/9/94	1000
H-121 M T	Distortion of A-2 Steel	8/2/94	8/15/94	1000
H-122 NM RM,E	Carb & Harden 1018 Railroad Castings	8/9/84	8/16/94	60,000
H-123 M T	Manganese Present in Vacuum Furnace	8/1/94	9/15/94	500
H-124 M I,T	Info on Oxygen Sensors	8/2/94	9/24/94	500
H-125 M I	Info on Carburizing Boost Cycles	7/19/94	8/9/94	500
H-126 NM T	Cracking 52100 Choke Tubes	7/26/94	8/15/94	1000
H-127 NM R,I	Ion (plasma) Nitriding 20' Paper Roll	8/23/94	9/8/94	could not help
H-128 NM I	Parts for Dew Cup Dewpoint meter	8/23/94	8/25/94	500
H-129 NM I	Straightening 4340	8/26/94	8/26/94	500

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Friday, June 12, 1995

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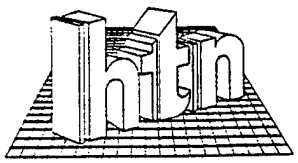

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-130 NM I	Ion Nitriding Info	8/1/94	9/9/94	1000
H-131 NM I	Austempering Info	9/8/94	9/8/94	5000
H-132 M I	Stress Relieving of 1350 Aluminum	7/18/94	7/18/94	1500
H-133 NM T	Copper Deposits on Furnace Elements	8/19/94	2/24/95	10000
H-134 NM RM,I	Sources for Solution Treatment of T-356	9/8/94	9/8/94	1000
H-135 M T	Cracking 1050 Bolts	9/12/94	9/23/94	3000
H-136 M R,I	Boriding H-13 Pins	9/13/94	9/15/94	1500
H-137 M I	Info on Vibratory Stress Relieving	9/13/94	9/22/94	500
H-138 NM RM,I	Source for Cu-Be aging of 12'part	9/19/94	9/23/94	1500
H-139 NM R,T	Distortion of 1050 Spring Clip	9/28/94	12/15/94	10000
H-140 NM T	H.T.&Chemistry vs. Formability of 410 S.S.	10/7/94	10/7/94	10000
H-141 NM T	Annealing of Nitrided 4140 Steel	10/11/94	10/11/94	1000

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Friday, June 12, 1995

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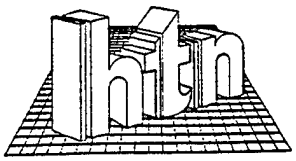

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-142 M I	SPC of heat treating operations	10/12/94	10/15/94	1500
H-143 M T	Thin Carburized Case	10/25/94	10/30/94	2500
H-144 NM R,I	Source of Infrared Temperature Analyzer	10/28/94	10/28/94	2500
H-145 NM RM,I	Anneal 87" 316 SS Casting	11/1/94	11/15/94	1500
H-146 M T,R	Source for Nitrogen-Methane	12/6/94	12/7/94	10000
H-147 NM I,T	Changeover Oil Quench Tank to Water	12/8/94	02/27/95	5000
H-148 NM R,T	Refractory Search	12/15/94	12/28/94	40000
H-149 NM T	Eco-system in Aluminum Solution Treating Quench Tank	01/04/95	01/30/95	10000
H-150 NM R,E	Source for Large (up to 20' long) N Hardening	01/11/95	01/30/95	25000
H-151 NM R,E	Source for Sursulf Salts	01/12/95	01/12/95	1000
H-152 NM I	Method for testing for Banding in 4140 bars	01/16/95	01/20/95	10000

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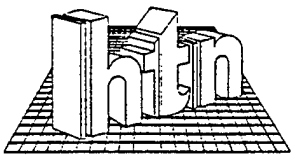

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-153 NM I	Information on Austemper of 1074 vs 6150	01/16/95	01/17/95	5000
H-154 NM RM,E	Source for Solution Treating of 300 Series Stainless Steel	01/16/95	01/16/95	50000
H-155 NM I	Information on Training for Vacuum Brazing	01/16/95	01/18/95	1000
H-156 NM R,I,T	Alternative to Trichlor for cleaning parts	1/16/95	03/03/95	50000
H-157 NM T,RM	Nitriding of Austenitic Stainless Steels	1/17/95	01/20/95	10000
H-158 NM T	Distortion of 86B30 during quenching	1/18/95	01/26/95	5000
H-159 NM RM,I	Referral for Hydrogen Belt Furnace heat treating	1/23/95	01/23/95	10000
H-160 M T	Nickel plating of Nitrided Surface Causing Surface Cracks	01/25/95	01/27/95	2500
H-161 NM T	Spring Application of 300 series SS	01/26/95	01/30/95	5000
H-162 NM I	Sludge & Scale in Polymer Quench Tank	01/26/95	02/27/95	could not help

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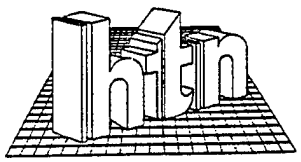

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-163 M T	Low Surface Hardness on Carbonitrided 12L14	01/27/95	02/24/95	5000
H-164 NM T,I	Carbonitriding Problem	01/30/95	2/5/95	500
H-165 M I	Annealing of 80-603 Ductile Iron	01/31/95	01/31/95	500
H-166 M T,I	Magnetic Anneal of Carpenter 52	02/02/95	2/5/95	500
H-167 M I,E,T	Looking for Alternatives to Lead Quenching of H-13 Tool Steel	02/06/95	02/27/95	2500
H-168 NM I	Information on 1144 Steel, Coarse Grain Structure	02/06/95	02/06/95	500
H-169 M I	Information, Rules, Guidelines for Safe/Environmentally Friendly Quenches for 4140 Steel	02/06/95	02/24/95	10000
H-170 M R,T	Hard Facing Aluminum Die Cast Plate	02/16/95	02/24/95	500
H-171 NM R,I	Stamping Problem - Steel Sheet Too Hard, Needs a Local Heat Treater to Anneal	02/16/95	02/24/95	10000

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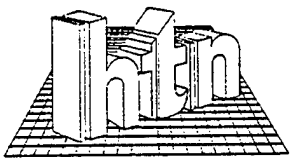

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-172 NM RM,I	Source for Heat Treater Bar Stock 10' Long 4140	03/06/95	03/06/95	500
H-173 NM R,I	Need Source for Speciality Induction Hardening Equipment	02/21/95	02/21/95	80000
H-174 NM RM,I	Source for Annealing 4140 Forgings	02/25/95	04/07/95	150000
H-175 NM I	Need Referral for Cost & Startup of Vacuum Furnace or Induction Operation	02/10/95	02/10/95	500
H-176 NM RM,I	Source for Gleason Press Quench of 1050 Rings	02/24/95	02/27/95	20000
H-177 NM RM,T	Needs Heat Treater for Annealing Nose Rings AISI 4340	02/28/95	02/28/95	10000
H-178 NM T	Fish Eyes / Inclusion Failure	03/01/95	03/01/95	10000
H-179 M I	Grain Growth in 1040 Induction Harden Bars	03/01/95	03/01/95	500
H-180 NM R,I	Source for Stop-Off Paint for Carburizing	03/07/95	03/08/95	1000

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Friday, June 12, 1995

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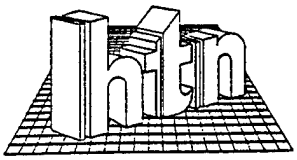

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-181 M I	List for 4140 Size Change/Tempering Temperature	03/09/95	03/10/95	1000
H-182 NM I	Looking for speakers: license process/salt baths	03/20/95	03/20/95	500
H-183 NM R,I	Heat Treater in Midwest to do 13,000 lbs. Ductile iron Large ring (normalized)	03/23/95	03/23/95	1500
H-184 NM I	Stain on Aluminum Castings (**sent EPA regulation policy**)	03/22/95	03/24/95	1000
H-185 M R,I	Estimate for High Volume Aluminum Heat Treating	12/08/94	12/22/94	185000
H-186 NM T	RDS Tool Steel Shaft Cracks after Hardening	03/28/95	03/30/95	1000
H-187 NM T	Carbon Pick-up in Stainless Steel (410)	03/29/95	04/05/95	35000
H-188 NM RM	Heat Treater with 6' long furnace/ 1018 bar stock	03/30/95	4/7/95	1500
H-189 NM RM	80 tons SAE 1065 needs H.T.	03/31/95	4/2/95	480000

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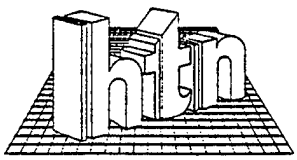

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-190 M T	H 19 parts sticking to basket	08/16/94	08/16/94	10000
H-191 M E	Capital Investment Solution Treat Drop Furnace	12/20/94	12/22/94	50000
H-192 NM T	AISI 1095 Hydrogen Embrittlement	4/6/95	4/10/95	10000
H-193 NM R	Source for Titanium Heat Treating	4/13/95	4/13/95	500
H-194 NM I,T	Predicting distortion on 8620 carburized parts	4/13/95	4/14/95	1000
H-195 NM I,T	Using Iron-Aluminides for Ion Nitriding	4/18/95	5/10/95	500
H-196 M I	How to Heat Treat ASTM A-532 Cast Iron	4/18/95	4/18/95	500
H-197 NM T	Questions on Heat Treating 414 SS and Atmosphere Tempering of 4140	4/18/95	4/18/95	1000
H-198 NM T,R	Loss of Hardness on 3310 Carburized Gears	4/18/95	4/18/95	10000
H-199 NM T, I	Extended Stress Relieve of Titanium	4/24/95	4/25/95	1000

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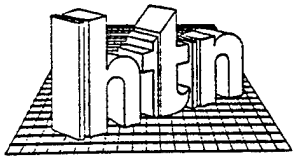

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-200 NM RM	Source For Mar Tempering	4/25/95	4/26/95	500
H-201 M T	Surface Finish On H.T. & Brazed Part(Porosity)	4/27/95	5/11/95	2500
H-202 M I, R	Source For Micro hardness Tester	4/27/95	5/11/95	10000
H-203 M T	9310 Not Cased Deep Enough	5/5/95	5/10/95	5000
H-204 NM I, R	How to H.T. 4340, S-L Source for H.T. Equip.	5/5/95	5/11/95	20000
H-205 M I	Request for Info on H-155, H-169, H-181	5/8/95	5/10/95	500
H-206 NM R	Source For 40' Heat Treating	5/10/95	5/11/95	5000
H-207 NM I RM	Source For Q&T of Forgings	5/10/95	5/12/95	90000
H-208 NM RM	Source For H.T. 304 SS Controlled Environment	5/15/95	5/15/95	500
H-209 NM Rm, T	Source For "Shrinking" Ceramic Blanket and Technical Help	5/22/95	5/26/95	10000
H-210 M R, I	Source For Cleaning of 4140 in Alkaline	5/22/95	5/25/95	10000

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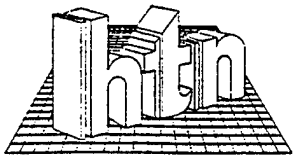

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-211 M T, I	Post Welding Heat Treating for Al (6061-T6)	5/23/95	5/25/95	1000
H-212 NM T, I	How to H.T. Beryllium-Copper (for Less Distortion)	5/31/95	6/6/95	10000
H-213 NM I,T	Equipment for H.T. in a Cellular MFG.. Environment	6/1/95	9/14/95	2500
H-214 NM Rm	Source for Annealing (SPH. Anneal 52100)	6/5/95	6/7/95	100000+
H-215 NM Rm	Source for Post Weld S.R. of Large Ladles	6/7/95	6/9/95	5000
H-216 NM RM	Source for reducing atmosphere in treating metallic foam	6/12/95	6/12/95	500
H-217 NM I,T	Grain size problem for 41L40 (ref H-168)	6/14/95	6/14/95	2500
H-218 NM T,I	Source to do Calcimine of Refractory Brick	6/14/95	6/14/95	500
H-219 NM T,I	Alternatives to Salt-pot Heat Treating	6/14/95	6/15/95	1500
H-220 NM T,I	Information on T-couple maintenance & calibration	6/15/95	7/6/95	500

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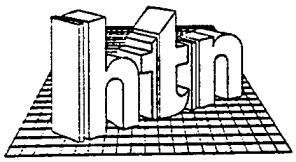

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-221 M T,I	Info on Difference of T-4, T-42, T-6, T-62 for 6061 & 7075 Al	6/16/95	6/26/95	500
H-222 NM T,I	Source for Rapid Thermal Annealing	6/16/95	8/18/95	15000
H-223 NM T,I	Info on Mobile Heat Treating	6/16/95	7/10/95	could not help
H-224 NM T,R	Source for Pack Carburizing Compound	6/20/95	6/22/95	1000
H-225 NM T,R	Info on Distortion of Aluminum	6/20/95	6/20/95	1000
H-226 NM T	Specifications for Decarb of 1045	6/21/95		
H-227 NM R	Source for 190F "Hot House" Curing	6/21/95	6/22/95	5000
H-228 NM RM	Source for HT of 450SS in Argon Atmosphere	6/22/95	6/22/95	2500
H-229 NM R,I	Source for Carburizing Stop-off Paints	6/23/95	6/23/95	500
H-230 NM RM	Source for Salt Bath Carbonitriding	7/5/95	7/5/95	1250
H-231 NM RM	Source for Ion Nitriding	7/10/95	7/10/95	1000

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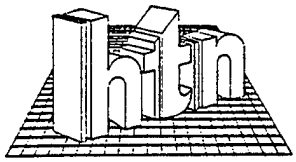

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-232 M I	Need Mil Specification ST-105	7/19/95	7/25/95	500
H-233 NM E, RM	Needs source for consistent heat treating of M4 Tool Steel	7/19/95	7/25/95	1500
H-234 M T	Difference between Ferrite and Martensite of 4140	7/20/95	7/22/95	500
H-235 M T	Identify residue from brazing	7/20/95	8/18/95	1000
H-236 M I	Requesting HOTLINE Reports: H-189; H-206; H-214; H-220	7/22/95	7/28/95	1500
H-237 M I	Requesting HOTLINE reports: H-187; H-194; H-198; H-203; H-212	7/18/95	8/18/95	1500
H-238 M I	Source for Computer Software for HT Shops	7/24/95	7/24/95	5000
H-239 NM I,R	Looking for a Coating to Protect Steel from Oxidizing	7/24/95	8/18/95	1500
H-240 NM I	Seeking info on how much interest in industry for predicting metallurgical processes	7/21/95	8/11/95	0

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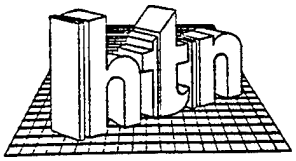

Heat Treating Network

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-241 M I	Info on Annealing and Hardening of Warrenite Cast Iron	7/26/95	8/1/95	1500
H-242 NM I	Info on Ceramic Gas Fired Tubes	7/27/95	7/27/95	500
H-243 M I,R	Info on Seminar by Satellite for Induction Heat Treating (ASM)	7/21/95	8/8/95	1200
H-244 NM I	Info on Carbonitriding Prctices of 12L14 Bearings	7/27/95	8/10/95	2500
H-245 NM E, R	Source for Automotive Certified Rack & Barrel Zinc Plating	7/31/95	8/11/95	50000
H-246 M T	1541 Steel Nails - wants Maximum Magnetic Retention and Highest Hardness	8/1/95	8/4/95	500
H-247 NM R	Source to Hydrogen Anneal HIPERNON Sheets 0.62"x30"x120" for minimum distortion	8/2/95	8/11/95	50000
H-248 M RM	Source for Marquenching 9310 Spur Gears	8/3/95	8/8/95	2500
H-249 NM I,R	Info on Fluidized Beds, Can't use Vacuum	8/8/95	8/11/95	50000

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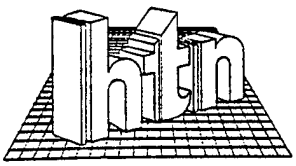

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-250 NM RM	Source for HT of Titanium (Ti64) water quench	8/9/95	8/18/95	2500
H-251 NM I	Info on Recuperative Combustion Systems	8/9/95	8/18/95	500
H-252 NM T	Can Beryllium Copper M25 be Annealed and Re Heat Treated?	8/10/95	8/11/95	1000
H-253 NM RM	Source to Carburize Cold Roll Steel	8/10/95	8/10/95	100
H-254 NM R	Source to Heat Treat 32' long x 8" wide Beams	8/14/95		
H-255 NM RM	Source to Heat Treat to Automotive and Aerospace Standards	8/16/95	8/28/95	150000
H-256 NM I	Info on Sealed Retort Furnace to Purchase	8/17/95	8/17/95	75000
H-257 NM RM,R	Source to Flame Harden 8620 Steel	8/21/95	8/21/95	500
H-258 NM T, I, R	Pusher Furnace Track Problems, Loads are "Crashing"	8/21/95	8/22/95	35000
H-259 NM RM	Source for Heat Treating Bolts (50,000 lbs per week)	8/21/95	9/13/95	225000

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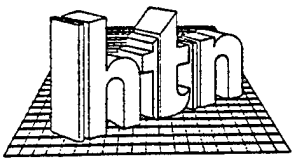

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-260 NM RM	Furnace Atmosphere Probe Problems	8/24/95	8/28/95	7500
H-261 NM RM	Source for Austemper of CRS 1050 Retainer Clips	8/29/95	8/29/95	15000
H-262 M T,R	Info on Reccomended Procedure to Soften Shank Ends of Drill Bits	8/30/95	8/31/95	500
H-263 NM T	Info on Removing Embrittlement after Black Oxidizing on S5 Steel RC 50-54	8/31/95	9/1/95	7500
H-264 NM I,T,RM	Recommendation for Case Hardening Low Carbon Steel for Minimum Distortion and Maximum Hardness While Maintaining Ductility	9/5/95	9/18/95	2500
H-265 NM T	52100 Parts are Turning "Blue" After Quench on Belt Furnace	9/5/95	9/15/95	12000
H-266 NM I,R	Source for Hardness Testing Files	9/11/95	9/12/95	250
H-267 M T	Problem Checking Hardness of WasHers made of 17-7ph SS	9/11/95	9/11/95	500

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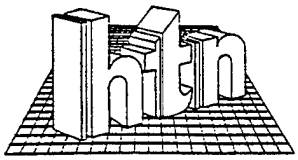

Heat Treating Network

HOTLINE NUMBER LIST

Hotline	Description	Start Date	Closing Date	Economic Impact★
H-268 NM RM	Source for HT 4130 in Polymer Quench	9/11/95	9/15/95	500
H-269 NM I	What is Moray 2 and will it Oxidize at 1650F in Air?	9/12/95	9/14/95	500
H-270 NM R	Source for Large Gear and Pinions in Eastern US for this English Company	9/14/95		
H-271 M	Source for Aluminum Heat Treater for Test Site for Nitrogen System	9/15/95		
H-272				
H-273				
H-274				
H-275				
H-276				
H-277				

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APPENDIX G

HOTLINE TECHNICAL ARTICLES

HTN Hotline

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OOT PREVENTION

Q *During a long carburizing cycle, we encounter furnace sooting. How can we adjust our air or oxygen mixture to inimize the sooting?*

A First, be certain that your gas analysis equipment is working correctly and is properly calibrated. For long carburizing rcles, a dew point in the 30-35°F range and CO_2 bove 5% (by the addition of air) should greatly educe sooting.

PM-M4 GROWS DURING HEAT REATMENT

Q *We heat treat compacted powder metal (CPM-M4) parts in vacuum for a hardness of R_c 63. Previously, our process resulted in a part growth of 0.0002 in. and produced a gold surface color. Recently, part rowth has increased to 0.002 in. and the surce has changed to a silver color with black ots. Please comment, and could you recomend a process?*

A We consulted with several HTN members that have vacuum capability and with the powder metal supplier. The consensus as that for R_c 63 hardness, a growth of 0.0015 ./in. is typical when parts are properly heat eated. It was suggested that the process should onsist of heating the parts to 2,150°F in vacuum ith a fast quench. Tempering should be done at .025 to 1,050°F due to secondary hardening, sing three draw cycles at times of 1.5 h to 2.0 h.

NCREASE FURNACE TUBE LIFE

Q *A ceramic coating company approached us with a product they claimed would increase furnace tube fe. The cost was quoted at about $450 per ibe. Do you know anyone that has used the rocess long enough to determine if it's cost ffective?*

A We contacted the vendor to learn more about the process and a HTN member who has experience with ceramic-coated tubes.

The results of our investigation revealed that a lower alloy tube could be coated to achieve a life of three years and was considered cost effective for another member (who had previously been getting only one-year life out of his tubes). Since you are using a higher alloy tube, you will have to weigh the economics and marginal costs of using low alloy and coating or high alloy and no coating.

HEAT TREATING 15-5 STAINLESS

Q *We're having trouble keeping a bright surface on parts during a temper/age heat treatment in a vacuum furnace. The parts were displaying a blue or straw color after heat treating at 1,000°F for 5 h in vacuum. Our client does not want to use a nitrogen atmosphere. Why the color change, and what can we do about it?*

A Residual oxygen is what is causing the discoloration. We suggest back filling the vacuum furnace to remove the residual oxygen. In addition, since argon is available, it could be used as an atmosphere.

PROCESSING NITRONIC 60

Q *How can we heat treat Nitronic 60 to a 160,000 psi ultimate tensile strength? Our customer is asking us to heat treat to MilSpec. H-6875, but we can't find information on increasing the strength of Nitronic 60.*

A Nitronic 60 and similar austenitic alloys are not heat treatable to increase strength. For added strength, work hardening is sometimes used. However, the purpose for heat treating these alloys is usually for stress relieving.

MINIMIZING DISTORTION IN STAINLESS

Q *When hardening 420 HC stainless steel to R_c 57 to 59, we are experiencing a 30% rejection rate on the required flatness (±0.003 in.) specification. The parts (pocket knife files) are being processed in batches as single layers. How can we minimize distortion?*

A Two possibilities come to mind. The first change in the process would be to stress relieve the parts at 1,100 to 1,200°F for 1 h. The second suggestion is to process the parts as uniformly as possible, such as a single layer orientation, similar to what is achieved on a mesh belt.

SPOTTY HEAT TREATING

Q *Is there any reason to be concerned about the spotting we are getting in the zinc phosphate coating when we carburize 11L44 steel?*

A The spotting condition is normal for zinc phosphate coated parts that are heat treated. Several cleaning procedures have been used to remove the spots after heat treating. In this case, considering environmental concerns, we recommend an acid cleaning and shot-blasting process.

REMOVING SURFACE LEAD

Q *Leaded steels occasionally have soft spots because the smeared load on the surface interferes with surface treatments. How can we remove the lead that appears on the surface after machining?*

A There are four possible treatments:
- 20% fluoroboric acid at room temperature for 2 min.
- 30% nitric acid at 160°F for 10 min.
- Concentrated potassium hydroxide at 600°F for 20 min.
- Heat parts to over 800°F in an oxidizing atmosphere, water quench, and shot blast.

CORRECTION: *In NITROCARBURIZING VS CHROME (May/June 1994) the line that read: "...the wear resistance my not be as good," should have read: "...wear resistance may now be as good." We regret any inconvenience this error may have caused you.*

To introduce METAL HEAT TREATING readers to the hotline service, HTN as offered readers the opportunity to call it, 216-243-8990 or 800-736-7195, one time, free of charge.

For more information on the Heat Treating Network, Cleveland, OH, ***Circle 301 on the Info Request Card.***

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SCREWY RESULTS

Q *We have been successfully heat treating self-tapping screws made from 1022 steel for several years. Recently, the parts began failing the customer's drill test. Double case hardening the parts has brought us limited success.*

The screws used to be fabricated by a different source, and the material vendor had changed. Another variable to consider is that the furnace has been rebuilt since the last good lot. With so many variables, what is the best way to troubleshoot this problem?

A If the heat treating process worked before, the material should have responded favorably. Since this is not the case, we would suspect the material and want to check aluminum level and grain size, both of which could contribute to poor hardenability.

If the material checks out, you might want to consider retrofitting the furnace muffle and retort to the old design that was successful in the past. With the new design, it's possible that endogas and/or nitrogen gas may be cooling the parts and not allowing them to be properly austenitized and quenched.

AUSTEMPERING TO R_c 55

Q *We have been heat treating hand tools made from 1072 steel to a R_c 50-52 hardness. Recently, the customer changed the specification to R_c 55, which we cannot achieve with 1072 when austempering. Would 1080 provide the desired hardenability?*

A A literature search revealed that 1080 would not offer the hardenability required with the salt quench at 600°F. A change to 1090 steel might work, but the parts should be tested prior to a production change.

The parts should be austenitized and then salt quenched at 600°F and held for two hours to avoid continuous carbide formation, which could cause brittleness in certain sections.

You might also want to consider using an alloy steel such as 1500-series 1541 or 1572.

OUT-GAS MEASUREMENTS DURING BRAZING

Q *We braze tungsten carbide to 4140 steel with a chromium nickel-boron alloy in a vacuum furnace. Occassionally we incur out-gassing, which results in porosity and/or delamination at the interface. Could we use gas spectroscopy to analyze the elements, and to differentiate material lots or suppliers?*

A Spectroscopy has been shown to be a resonable method in determining the contaminants from out-gassing materials in a vacuum furnace. However, in your process, the concentrations may be too low to detect some elements.

We would suggest running several tests using time-at-temperature as a variable. The time should be increased to allow the gasses to escape the liquid metal prior to solidification. Then choose the lowest acceptable time for a quality part.

You might also try etching the interface to more easily detect any porosity during the tests. The temperature of the melt should be about 50°F above the liquidus temperature of the braze alloy. A temperature too high will allow porosity to occur.

LONG-LIFE FIXTURES

Q *A new furnace was installed at our shop that we expect to operate continuosly at 2,000°F. What material should we use for fixtures to ensure long life?*

A Fixtures subjected to continuous use at 2,000°F would benefit from the use of nickel-based alloys such as Inco 600 and Inco 601, which provide good durability. Also, depending on the fixture design, ceramic materials can be used, especially for spacers and similar applications.

RECUPERATORS COMPARED

Q *We are rebuilding a Super 36 batch furnace, which includes the installation of a recuperator system. Have there been any independent studies comparing the two?*

A Members of the Heat Treating Network report that plug-type systems are 60% efficient and do not take heat away from the radiant tubes, as sometimes thought. Stack-type systems have been found to be 55% efficient.

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LOSING HARDNESS OVER TIME

Q *We are successfully heat treating parts in a spring application to R_c 45-48. However, after being in use for about two years, hardness drops to R_c 20.*

The parts had a thermal treatment of 1,500°F for one hour, oil quench, then temper at 800°F for two hours. The component dimensions are 1/4 in. thick × 1 in. wide × 10 in. long. The spring was two ply and attached at one end only. Duty cycle for the spring is to cycle in one direction and return to rest five times in 24 hr. Operating temperature was about 200°F for two years.

Do you have any idea why these parts are losing hardness, and what we can do to prevent it?

A Members contacted for advise say that the alloy you are using is not suited for operation at 200°F because it is a cold working tool steel. In addition, it is also a low-alloy content steel. If available in the needed form, H-11 would be a good choice. When the alloys have very little chromium content, they can over temper at relatively low temperatures.

HYDROGEN EMBRITTLEMENT

Q *A part we are heat treating for a wheelchair lift has to be either carburized or carbonitrided (1018 and 1026 steels are involved). We have no experience with carbonitriding and need to know if a special treatment is needed to prevent hydrogen embrittlement when using the process? Originally, the parts were to be carburized and tempered.*

A During carbonitriding, hydrogen embrittlement is not a problem. Concern for this problem is found mainly in processes such as chrome plating of metal parts. In those cases, the hydrogen that diffuses into the metal is baked out at specified times and temperatures depending on the alloy, depth of chrome plate, and size of the part.

TEMPERING 304 STAINLESS

Q *We need a process to reduce the hardness of 304 stainless steel from R_c 45-50 to a maximum of R_c 36. Can you provide us with a tempering cycle?*

A Because 304 stainless steel achieves its hardness through work hardening, parts that are tempered can not be rehardened if hardness is reduced too low. It is suggested that tests be conducted to determine the correct amount of time parts must be held at temperature. Test parts should be heated to 1,000°F and held at temperature for 15 min. Then one part should be removed and cooled. Repeat the process every 15 min. for each of the remaining parts, noting the time interval used, and test each part for hardness until you determine the proper time interval for the desired hardness.

KNIVES DISCOLORING

Q *We make knife blades from heat treated A-2 steel. The knives work fine and hold an edge but, when used to cut foods with a high acid content, the steel turns black. Is there any heat treating process that we can use to prevent the discoloration?*

A The problem is that A-2 steel only contains about 5% chromium and will not act as a stainless steel when exposed to harsh environments. Therefore, if a bright finish is desired, a stainless steel should be used. If the customer insists on continuing to use A-2 because of its edge-holding properties, then a bluing process may at least help keep a uniform surface color on the blade.

UNEXPECTED CRACKING

Q *After successfully heat treating parts made from 6150 in the past, we are now experiencing cracks in the latest batch. The cracks occur after quenching during heat treatment to attain a hardness of R_c 55-57.*

The same part design was successfully heat treated before using the following cycle: stress relieve at 1,000°F for 2 hr, 1,550°F for 6 hr; atmosphere; oil quench at 180°F; temper at 300°F for 3 hr.

Why are we suddenly developing cracks?

A The thermal cycle seems to be reasonable for the product and desired result. While the part design may be the same, the latest batch of parts might have sharp corners or machining marks that did not exist on previous parts—either could act as stress concentrators. If that is not the case, then a less severe quench cycle, such as interrupted quench, may be helpful. Another option is to change quench oils.

CLEANING UP YOUR ACT

Q *Small parts weighing less than 10 lb each were gas carburized. The parts were not cleaned prior to heat treating, even though they carried a residue of water-soluble cutting fluid. Despite the residue, heat treatment was successful. However, we are concerned about the lack of cleaning and wonder how other heat treaters feel about carburizing without first cleaning the parts.?*

A Several heat treaters in the Network state that cleaning parts prior to carburizing is good practice for several reasons:

- To avoid part surface contamination.
- Avoid furnace atmosphere contamination.
- Minimize smoke generation when the lubricant is burned off during heat treating.

For cleaning, we recommend an aqueous cleaner specifically made for cutting fluids.

PARTS STICKING TOGETHER

Q *Small round parts that we are heat treating nest when loaded in the furnace and about 5% stick together when heat treated in a vacuum furnace.*

The parts are heated to 1,900°F for one hour and nitrogen quenched in the vacuum furnace. They are loaded into 16 baskets 1/2 in. deep, 150,000 pieces per load.

Can you recommend some steps we can take to minimize sticking?

A We suggest you try one or more of the following to relieve the part sticking:

- Oxidize the surface to prevent metal to metal contact.
- Use lighter loads in the baskets to help prevent the nesting of parts.
- Sprinkle a small amount of talcum powder on the parts. This prevents direct contact, can be removed with an air blast, and does not harm the vacuum surface.

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NICKEL BRAZING

Q *We have a furnace that was originally designed for bright annealing of stainless steel. Would this continuous furnace with hydrogen-nitrogen atmosphere and a cooling zone be suitable for brazing thin-wall tubing?*

A In order to be successful, a high enough temperature to melt the braze material and time enough for it to flow into the desired areas are needed. Without knowing the alloy and part geometry, time and temperature recommendations can not be made. However, basically, the braze alloy should be allowed to solidify, with rapid cooling following to 900°F. This would avoid carbide precipitation (assuming that the base material was a 3000 series stainless steel.) The atmosphere should also be dry, having a very low moisture content.

ANNEALING NITRIDED 4140

Q *Our customer would like us to anneal a batch of 4140 steel parts after nitriding for a dimensional change. Can we anneal these parts and reharden?*

A No. The parts may be annealed by heating to 1,450°F followed by a slow cool, but the parts will not renitride. It may be possible to grind or EDM the area and renitride the parts without annealing but your customer may have "bought the farm" on this one.

VANADIUM-FREE 4140 GEARS

Q *We've been asked to harden gears that use a new 4140 material with a larger grain size (ASTM 8-9) than we have previously encountered. Previous material contained vanadium and was finer grain (ASTM 10-11).*

The gears are 29 in. OD with a 26 in. ID, and are 5 in. thick. The previously successful thermal cycle was austenitize at 1,600°F in air and water-spray quench.

Could you suggest a thermal cycle for the new material? Cracking must be avoided.

A The original 4140 material containing vanadium would have carbides formed, which could make the material more prone to cracking. However, the fine grain size probably offset that. The new material is still relatively fine grain and should be acceptable. Try using your original thermal cycle as a baseline and check for cracking. If cracking occurs, reduce the quench rate by reducing water flow.

CRACKING 1050 BOLTS

Q *We periodically strip 1050 chromium plated steel bolts and sometimes fail our customer's bend test. We perform a quench and temper to attain a core of 30-40 R_c and induction harden to 50-55 R_c. Why do only some of the replated parts fail?*

A Inspection of both acceptable and unacceptable bolts reveal an interaction between the bolt's core hardness and hydrogen embrittlement from the stripping and plating. The acceptable bolt shows more martensite than the unacceptable bolt and comparable hardnesses of R_c 34 versus R_c 28 for the unacceptable bolt. This reduces the tensile capabilities of the failed bolt. Also, failure to bake after the acid dip embrittled the bolt's case.

It is the combination of both variables that cause the sporadic bend test failures. Try baking operations at 375°F for 3 hr. after the chrome plating and stripping operations in addition to fully austenitizing the core of the bolt to achieve the specified 30 R_c minimum core.

HARDENING 420HC STAINLESS

Q *We are using 420HC stainless steel to produce knife blades. In trials using carburizing and carbonitriding, we have been able to achieve only a range of R_c 56 to 58. The specification calls for R_c 60, with minimum distortion. Is there anything you could suggest that would enable us to get the extra hardness we need?*

A The carbon content of 420HC is insufficient to attain the desired R_c 60 hardness on the surface. You could try nitriding the surface, which would also minimize any distortion. If you decide to nitride, keep in mind that the 400 series of stainless steels are difficult to nitride due to interfering surface films. A grit blasting with alumina to clean the surface prior to nitriding is usually needed.

DISTORTION OF A-2 STEEL

Q *We are heat treating A-2 cutting mills and find some parts in the batch exceed the runout tolerance of 0.001 in. Is there anything that we might do to reduce the distortion?*

A Distortion of A-2, although usually minimal, may respond to careful racking of the parts during heat treatment. A statistically significant variable study of part runout by rack position and part position may give clues to your problem. Runout may also be reduced if the parts are stress relieved between rough and finish machining. A combination of both strategies may improve your product quality.

ANY REASON TO TEMPER?

Q *We use 4140 as a substrate for brazing in vacuum. As part of the process, the parts are normalized after brazing. The specification also calls for a temper to R_c 25-30, after normalizing. If the parts are already in this hardness range after normalizing, is there any reason to temper?*

A No. If hardness is at the desired level, tempering is not necessary. In fact, the microstructure in the normalized condition is fine pearlite. A temper could cause the grain size to grow and possibly change the mechanical properties of the material.

FIXTURE LIFE AT 2,000°F

Q *We recently installed a new furnace that we plan to operate at temperatures to 2,000°F. Can you suggest some materials we can use in fixture design that will live at those temperatures.*

A At continuous temperature around 2,000°F, the nickel-based alloys, such as Inco 600 and Inco 601, provide good durability. In addition, depending upon the types of fixtures being designed, ceramic materials can also be used, especially for spacers and similar applications.

To introduce METAL HEAT TREATING readers to the hotline service, HTN has offered readers the opportunity to call it, 216-243-8990 or 800-736-7195, one time, free of charge.

*For more information on the Heat Treating Network, Cleveland, OH, **circle 301** on the Reader Service Card.*

HTN Hotline

Originated in 1990, the Heat Treating Network (HTN), Cleveland, OH, is an independent, national association of heat-treating companies, suppliers, technical centers, and universities dedicated to ensuring the competitiveness and continued success of the nation's heat-treating industry.

INCREASE THE LIFE OF STAINLESS

Q *I am making a component out of 410 stainless steel and would lie to increase the life. Can 410 be liquid nitrided, gas nitrided, or plasma nitrided?*

A Yes, 410 stainless steel can be nitrided using any of the three methods:

Liquid nitriding is still performed in the United States primarily under various trade names. In general, the temperature range is from 950°F to 1,075°F. Typically, liquid nitriding is used for shallow (<0.005 in.) case depths. To process 410 stainless steel, no special surface preparation is required to facilitate nitriding.

Gas nitriding is the most common form of nitriding employed by heat treaters and has proven to be successful in nitriding stainless steels. The temperature range is 925°F to 1.100°F. Rather than utilizing the two-stage "FLOE" process, a single stage of 20% to 30% ammonia dissociation rate is more often used. For gas nitriding of stainless steel, special surface preparation, such as dry honing prior to nitriding, is required to remove the chromium oxide film that gives the stainless steel its corrosion resistance.

Plasma nitriding is becoming a more accepted and utilized form of nitriding. The temperature range for plasma nitriding is much wider than the other two forms: 700°F to 1.100° F for plasma nitriding, no special surface preparation is required, and the chromium oxide layer can be removed inside the furnace via "sputtering" in hydrogen just prior to introducing the nitriding atmosphere.

It should be noted that while nitriding of stainless steel can be accomplished by any of the three processes and will increase the surface hardness and, subsequently, wear resistance, there is a significant drawback. The hardness increases are due to the formation of chromium-nitrides. Unfortuantely, tying up the chromium in the case decreases the corrosion resistance of the component.

CRACKING 52100 CHOKE TUBES

Q *We are trying to use 52100 in place of 4140 in a shotgun choke. The 52100 cracks during toughness tests after being quench and tempered to R_c 45. Any suggestions?*

A Try austenitizing at 1,550°F and adding a 30 min. soak at temperature. You may not be allowing the carbon enough time to enter solution, which would cause part brittleness.

NITRALLOY 135 PINS CRACKING

Q *We have some pins made of Nitralloy 135 modified that have been nitrided and then electroless nickel plated. A metallurgical inspection made after plating shows a cracked case from the surface into grain boundaries. Can electroless nickel plating cause this cracking?*

A No. Further discussion revealed that the "cracks" were filled with nickel plating, which indicates that the cracks were present before plating. The nitriding cycle used consisted of a standard FLOE process, plus an additional third stage to control white layer.

The FLOE process consists of a first stage at 975°F with an ammonia disassociation rate of 15% to 30%, followed by a second stage at 1,025°F with a disassociation rate of 80% to 85%. A third stage is added in applications where white layer must be controlled to tighter specifications, such as, 0.0006 in. maximum. While the temperature for this third stage remnains at 1,025°F, the disassociation rate is increased to 100%. When using this third stage, the length of time at 100% disassociation rate is critical.

It is suggested that testing be performed to determined the length of this stage. In general, $^1/_2$ hour to 3 hours is sufficient depending on case depth. When the time for the third stage is excessive, nitrogen is removed from the case. The first site of nitrogen depletion is at surface grain boundaries and when observed metallographically appears as cracks at the surface of the nitrided case. Review the length of your third stage and decrease the time.

CAN'T MAKE MINIMUM HARDNESS

Q *We are cabonitriding 12L14 screw machine parts to meet 0.015 in. minimum case depth and R12N-90 minimum surface hardness. We process at 1.600°F for 1 $^1/_2$ hours, which gives us approximately 0.18 in. case depth. When the case is evaluated using a micro hardness traverse, we find R15N (equivalent)-82.5 at 0.002 in. and R15N (equivalent)-89.8 at 0.005 in. What would cause this lower hardness?*

A Upon further discussion of the carbonitriding cycle, we discovered that a 10% ammonia content was employed in the furnace atmosphere. Nirogen lowers the transformation temperature of austenite and. therefore, can lead to retained austenite in the quenched case. Retained austenite can be transformed by "deep freezing" at -90°F to -150°F. In order to avoid the need to "sub-zero" treat carbonitrided parts, a cycle should be developed to minimize the amount of ammonia used. Many automotive specifications call for 3% to 5% ammonia content. As a starting point, cut your ammonia in half to 5%.

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N Hotline

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DRGINGS DISTORTION

are heat treating thin $^1/_8$ to $^1/_2$-in. ings of 86B30 in a continuous belt nace and are experiencing excessive n. The cycle is to austenitize at n a 0.28% carbon potential atmo-e oil quench in 175°F and temper at

ing parts dimensionally at every e process has revealed that most of rtion is occurring during the What can we do to eliminate it?

ough you have conducted dimen-al checking wherever possible, con-ous belt furnaces have a quench chute led, making it impossible to check stenitized, prior to quenching. There-discount the possibility of distortion during the austenitizing phase.

y to decrease distortion in the fur-ld be to decrease the feed rate to weight of parts piled on top of each much weight at the austenitizing re could account for almost all of tion you are experiencing. The loss tion could be partially offset by in-ie belt speed.

ng distortion from the quenching complished by several means:

ease the austenitizing temperature but be sure to set the belt speed to all parts soak out at this tempera-itor the parts either with a thermo-observe parts through a peephole.

ase the quench oil temperature. e to a "slower" oil.

ese suggestions should be accom-extensive testing to insure that the nechanical properties of the forg-ll being met.

tion, monthly monitoring of your quench oil is essential. Your quench oil supplier should be able to assist you in testing for water and solids contamination, speed, and viscosity to ensure that your oil is still meeting specifications.

CRACKING TOOL STEEL

Q *My company uses Carpenter RDS tool steel for shafting applications. Occasionally, we get parts back from our tool room that are cracked. What processing steps can we institute to eliminate this problem?*

A Carpenter RDS is basically a L6 material—a general purpose tool steel that can be hardened to R_c 62 and should be austenitized at 1,450°F to 1,550°F. L6 does not require preheating, but heat-up rate should be slow. Temperature should be held for 10 to 30 min. Parts should be quenched in "warm" oil (approximately 200°F). It's very important to temper immediately to prevent cracking.

HARDENING 410 STAINLESS

Q *We are starting to get several inquiries for hardening 410 stainless steel and the first load we ran came out with a surface of R_c 49/50 while the core is R_c 43/44. Testing revealed 0.0005 in. of carbon pickup. The specification is R_c 38/42 and we process in an endothermic atmosphere, internal quench furnace.*

What can we do to salvage these parts and what steps can we take to prevent this from happening to future loads?

A Unfortunately, the excess carbon in the part is tied up in chromium-carbides and diffusing or "breaking up" these carbides is all but impossible.

Depending on the specification (some are very specific on allowable levels of carbon pickup and should be reviewed with the customer), it is possible to increase the tempering temperature and draw the surface into the top of the hardness specification while holding the core hardness to the bottom of the specification.

A HTN member noted that when using this method, at temperatures above 950°F you will start to observe some secondary hardening at the surface.

Because you are using an endothermic atmosphere in a furnace that is also used for neutral hardening of higher carbon steels and carburizing, it is suggested that you give the furnace a good burnout (at least 18 hours) prior to processing future lots of these parts. Additionally, be sure that the parts are clean and free from any oils. Use the cleanest and newest baskets you have.

If the job can justify the expense, purchase a fixturing setup . Be sure that the carbon in the processing atmosphere does not exceed that which is in the 410 you are using.

INCONSISTENT HARDNESS

Q *We are heat treating pins made of 1144 that are 3.0 in. long and about $^1/_4$ in. diam. After austenitizing at 1,550°F and tempering at 850°F, we are getting inconsistent hardness readings. The ends are meeting the specification of R_c 38-42 but the core is as low as R_c 20. Our quench medium is maintained and exceeds our minimum requirements. We have processed this part for years using the same equipment and the same recipe. Any suggestions on what the problem may be?*

A Metallographic evaluation showed that the grain size on this batch of parts was ASTM 10, very fine grained. Evaluation of past lots showed a grain size of ASTM 4 to 6. As the grain size decreases so does the hardenability. Even the best internal procedures and controls can not overcome material problems. Closely working with the customer when specifying material and processes can help prevent problems that the heat treater cannot control.

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BRITTLE WASHERS

Q *We have some washers made of SAE 1095 that are 1/16-in. thick. They have been quenched and tempered at 700°F to R_c 40/45, and have been cadmium plated. When the washers were being used in assembly, some of the parts broke in a brittle fashion. Checking our records, the washers are from two different sources but are now mixed together. We believe that one source did not bake after plating. Is there a fix?*

A The first thing to do is run a chemistry of washers that are brittle, as well as the chemistry of parts that are ductile to ensure that the steels are 1095. If the chemistries are the same, you can try baking all of the washers at 400°F for at least 8 hr. Then conduct more testing.

A plater with many years of experience says that cadmium plating is more susceptible to hydrogen embrittlement than any other plated metal. He also says that there is a time period when baking is most effective (he typically tries to bake within 4 hr of plating) and if these parts have been sitting around for several weeks or even months you have to strip, reheat, replate, and bake. Unfortunately, you would have to do this to all of the parts to ensure they all meet the required specifications.

HELP WITH ASTM A532

Q *We have received a request to quote on heat treating castings to ASTM A532 Class III type A. Could you give us some information on what the material is and how to heat treat it?*

A This is considered a "white iron" that has a chromium content between 23% and 28%. For maximum hardness, we suggest the following cycle and considerations: To avoid cracking during heat up, the parts should be slowly heated in a cold furnace to 1,200°F. Complex shapes should not be heated at a rate exceeding 50°F/hr. Above 1,200°F, heat up normally to the austenitizing temperature of 1,950°F and hold for 4 hr minimum and, for large parts, at least 1 hr/in. of thickness. Air quench (by cooling fan) to below the pearlite formation temperature (approximately 1,100°F) and then still-air cool to room temperature. To restore some toughness, tempering at 400°F for 4 hr is a common practice.

DECREASING RETAINED AUSTENITE

Q *As a manufacturer of specialized bearings, we use SAE 3310 for some applications. We carburize at 1,700°F, the first 30 hr at a dewpoint of 12F; the next 20 hr at 25F; and the last 15 hr with no natural gas additive to the furnace. The parts are then cooled to 1,525°F and held for 3 hr before quenching in oil at 175°F. Parts are then tempered to R_c 58/60 surface hardness. Between 0.020- in. and 0.070-in. depth, the case hardness drops to R_c 48, and then goes back up to R_c 58, which seems to indicate retained austenite. How can we change our process to decrease the retained austenite?*

A The first and most obvious process step to transform retained austenite is to add "deep freezing" to your procedure. Another method of reducing retained austenite that would avoid the potential for micro cracking of the carburized case during deep freezing would be to furnace cool the parts after carburizing, then re-austenitize at 1,500°F, hold for 1 hr/in. of thickness, and then quench.

TOO MUCH RELIEF?

Q *Recently we were performing a post-weld stress relieve on some components made of AMS 4910 titanium alloy. The customer specified 1 hr at 1,150°F in air. During the cycle, our controller malfunctioned and the parts stayed at temperature for 6 hr. Are the parts scrap?*

A AMS 4910 titanium alloy is an alpha alloy (Ti-5Al-2.5Sn) and cannot be strengthened by heat treatment because the alpha structure is a stable phase. The 1 hr at 1,150°F specified is to decrease any undesirable residual stresses from welding. Reference material states that 70% of the residual stresses are relieved in the first hour of stress relieving. No significant changes in the microstructure can be observed metallographically, so the only method of measuring the effect of stress relieving is with x-ray diffraction. If there was no significant surface oxidation caused by the extended time at temperature at the extended time, the parts are probably acceptable metallurgically. However, since the parts were not processed to specification, the customer must be notified of the discrepancy and sign off for acceptance via a deviation.

LOW SURFACE HARDNESS

Q *Carbonitriding of 12L14 is a process that we perform several times a week. Occasionally, we get a load that comes out with low surface hardness. Deep freezing these parts does not improve the hardness and that leads us to believe that the problem is not retained austenite. What could the problem be and how can we avoid it in the future?*

A Metallurgical analysis of the parts did not show retained austenite. Instead, a polished and un-etched part displayed subsurface porosity in the cabonitrided case. This type of porosity is associated with excess ammonia additives. It can be caused by several variables and to avoid this formation tight control must be used when carbonitriding. Some of the variables that lead to voids include: increased cycle temperature, high nitrogen levels in the case long cycles, adding ammonia during the heat-up stage of the cycle. In addition, the carbon potential of the atmosphere must be at the desired level before introduction of the ammonia additive. Also, reprocessing of carbonitrided part leads to porosity in the case. Unfortunately, once the voids are formed, they can not be "heated" or "filled back in." Tight controls in processing is the key to avoiding this problem.

To introduce ***METAL HEAT TREATING*** *readers to the hotline service, HTN has offered readers a one-time, free of charge opportunity to call the Hotline at 216-243-8990 or 800-736-7195.*

For more information on the Heat Treating Network, Cleveland, OH, ***circle 301*** *on the Reader Service Card.*

HTN Networking News

HTN'S CAPABILITY BASE

Heat Treating Network conducted a survey of its network members to determine their equipment types and sizes, process capabilities, and specialties in order to update our database and enhance our HOTLINE service. The information acquired reveals specific heat treating processes and specialties, which include: brazing, straightening, black oxidizing, electroplating, shot peening, sand blasting, glass beading, bluing, sintering, and boronizing to name a few. We have members with multiple metallurgical engineers on staff with fully equipped metallurgical laboratories. Some members are NADCAP certified and ISO 9001 approved. Many are qualified sources for the automotive industry an din military specifications. Member facilities maintain equipment varying in dimensions to accommodate many sizes of materials. Call HTN's hotline at 800-736-7195 for assistance with your heat treating needs or include your company's unique services by becoming a HTN member.

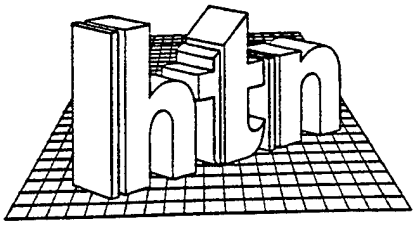
HEAT TREATING FOR NON-HEAT TREATERS

Back by popular demand, the Heat Treating Network along with the assistance of the membership will host Heat Treating for Non-Heat Treaters seminars. The tentative schedule is set for late September and early October in the Cincinnati/Dayton, Toledo/Detroit, and Cleveland areas.

If you would like to be included on a mailing list to receive updated and detailed information, please contact HTN no later than August 30, 1995.

HTN'S NEW ADDRESS

Heat Treating Network has moved to new offices at 16600 West Sprague Road. Please make note of our new suite, #275. The telephone and fax numbers will remain the same.



DIRECTOR'S CORNER

Recently, Heat Treating Network conducted a capability survey of its membership. I know of the extensive experience and expertise our membership represents, but I was amazed by the amount of equipment and process capabilities they possess.

Essentially, for every call that comes in via our HOTLINE searching for a commercial shop with specific capabilities for processes and materials, there is at least one and often several members who can manage the task.

This funneling of requests for heat treating, both standard and unique, has led to new jobs and customers for our membership. The HTN members are progressive visionaries dedicated to improving the heat treating industry. Call today and become part of HTN's enterprising capability team.

PARTS CLEANING PROJECT

In the coming weeks, HTN will be surveying the network members focusing on their current methods of cleaning parts before and after processing. This joint study between HTN and Los Alamos National Laboratories will concentrate on moving the heat treating industry toward environmentally friendly cleaning of parts while maintaining the required standard of cleanliness need for proper treating.

Non-Heat Treating Network members are welcome to partake in this survey. Contact HTN by fax, phone, or letter to be considered as a participant in this poll.

GROUP PURCHASING OF NATURAL GAS

The concept of this program is to combine the purchasing power of the entire network to obtain the lowest possible rate for HTN members' natural gas purchases. Without question, our negotiating power as a group is much greater than that of any individual. HTN has evaluated the proposal submitted by leading gas suppliers focusing on a marketer who can furnish the membership with exceptional services and financial returns.

If you would like to take part in this exciting members' opportunity, contact HTN about joining the network.

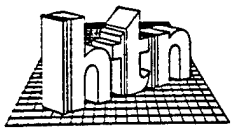
For more information about the Heat Treating Network, contact Heat Treating Network, 16600 West Sprague Rd, Suite 275, Cleveland, OH 44130-6318. Tel. 216-243-8990 or 800-736-7195; fax 216-243-8992; Email HEATNET@aol.com or Compuserve 76470,3122; or ***circle 302*** *on the Reader Service Card.*

HTN Networking News

The Heat Treating Network (HTN) is a not-for-profit, technical organization specializ-ng in the heat treating industry. The membership is an alliance of industrial, academic, nd government entities. Members share in technological developments, build alliances, nd receive practical and timely solutions to their heat treating problems in a effort to ise the technical level and awareness of the heat treating industry. Assistance and infor-ation is available to the membership at no charge and non-members whenever possible. ompany memberships, based on annual gross sales, start at $1,000 annually.

APPRENTICESHIP PROGRAM ANNOUNCED

The HTN Apprenticeship Project is offering pportunities for heat treating companies to articipate in this innovative alternative for pgrading heat treating workforce skills. The roject will develop work skill standards, ourse curriculum, and other requirements) gain appropriate state and federal accredi-ation. HTN is offering heat treating compa-ies the opportunity to reserve places in the rogram with a deposit of $700 per appren-ce. Currently, HTN has participants in the tates of Ohio, Pennsylvania, and Texas and is illing to work with companies in other states) install the program when completed in ap-roximately one year. A project description d task plan is available by contracting HTN.



DIRECTOR'S CORNER

It is a pleasure to welcome Roy Hardy to ITN as its new director. He is well know in the ndustry and will continue to promote HTN's rograms

HTN has evolved over the last few months) emphasize its technical programs. No other rganization can offer the heat treating indus-ry the combination of technical programs, hort term assistance, and access to knowl-dgeable people in over 35 industrial, aca-emic, and government organizations.

I will assist Roy along with the HTN staff to upport your technical questions, comments, nd insights. You can also expect HTN to con-nue to extend its relationship with other heat eating organizations such as MTI and ASM to nsure the fine resources of our industry are ot squandered on redundant programs. eamwork is our watchword and networking s our strength.

—Mark Brandt, interim director, HTN

NEW HTN DIRECTOR APPOINTED

HTN would like to announce Roy W. Hardy as its new director. Roy comes to HTN with over 10 years of commercial heat treating experience with companies such as AMAC, Metlab Co., HI TecMetal, and Shore Metal Technology. He received a BS degree in Metallurgy from the University of Cincinnati and an MBA from Cleveland State University. Please join us in congratulating Roy at 216-243-8990.

HTN HOTLINE ON THE MOVE

HTN is currently working on improving the HTN Hotline. A new, computerized support system is now on line, but that personal touch has not been compromised. Our people still answer and address your calls. The new system expands our access to valuable information and allows us to offer a more efficient service—the kind you can't get from a book. In addition, we have network members across the country available for clients requiring special attention in difficult situations. Use our Hotline number (800-736-7195) or contact us via CompuServe (76470,3122) to submit your problems, comments, and concerns.

CALL FOR ISO 9000 PARTICIPANTS

HTN is again offering a group rate on its ISO 9000 program for heat treaters and related industries. To date, four HTN members have participated in the program, which leverages small company "groups" to offer a proven ISO 9000 program at an attractive price. A free, informative workshop is offered to Ohio-area companies on February 15, 1995 at the Heat Treating Network headquarters. Call HTN for details and references form successful HTN members.

HTN BULLETIN BOARD

Electronic bulletin board. HTN's electronic bulletin board is close at hand. Call us for our new bulletin board address and sign-on information.

Furnace energy efficiency project. HTN is proposing to fund an energy efficiency project for gas-fired furnaces. It is estimated that the average furnace runs 20 to 40% inefficiently. HTN is looking for companies interested in participating with in-kind and cash donations to perfect a simple, user friendly, portable measurement procedure and trouble-shooting guide to restore peak furnace performance. For further information, contact Dr. Michael Aranov at American Gas Association Labs, 216-328-8108, or HTN at 216-243-8990.

Capabilities database. Thank you for your great response. Knowing your capabilities allows HTN to improve service to customers with difficult or oversized parts requiring heat treating services. If your company has not yet submitted a capabilities list with part capacities, please drop us a line via E-mail (CompuServe 76470,3122) or write to Mark R. Brandt, HTN Capabilities Database, 16600 Sprague Road, Cleveland, OH 44130-6318.

HEAT SOAK PROJECT TAKES OFF

The second phase of HTN's Heat Soak Project will make several HTN members happy by reducing the time parts heat up in their direct-fired furnaces. The project received a major portion of its funds through Mr. Steve Sikirica of the Gas Research Institute, a long time member of HTN. The information derived from this project will be available to interested heat treaters through HTN. Call HTN now to ensure that your company takes advantage of this offering.

For more information about the Heat Treating Network, contact HTN, 16600 West Sprague Rd, Suite 445, Cleveland, OH 44130-6318, Tel. 216-243-8990 or 800-736-7195, or ***circle 302 on the Reader Service Card.***

APPENDIX H

HOTLINE SUMMARY REPORT

HOTLINE SUMMARY REPORT
July 1994 - September 1995

HOTLINE NUMBER	HOTLINE CALLER	STATE	MEMBER	NON-MEMBER	# OF COMPANIES INVOLVED	TECHNICAL	INFORMATIONAL	MEMBER REFERRAL	NON-MEMBER REFERRAL	SPECIAL PROJECT	ECONOMIC IMPACT	SURVEY RECEIVED	VERIFICATION RECEIVED	TIME TO COMPLETE (Calendar Days)
118	Conforma Clad	IN	X		1	X					$5,000			13
119	M & M Heat Treat	MI		X	2		X				$500			4
120	FM Machine	OH		X	2			X			$1,000			16
121	Southeastern H .T.	NC	X		1		X				$1,000			13
122	McQuaid Associates	OH		X	5			X	X		$60,000			7
123	Solar Atmospheres	PA	X		1	X					$500			44
124	NASA Lewis Research	OH	X		3	X	X				$500			52
125	AACC/Zircoa	OH	X		1		X				$500			21
126	Tru-Lock Tools	GA		X	4	X					$1,000			20
127	International Paper	PA		X	3				X		$0			15
128	Modern Industries	PA		X	4		X				$500			2
129	Commercial Heating	WS		X	1		X				$500			1
130	Thurner Heat Treating	WS		X	1		X				$1,000			38
131	Andor Fabricators	OH		X	1		X				$5,000			1
132	American Heat Treat	OH	X		1		X				$1,500			1
133	Penn-Union	PA		X	1	X					$10,000			180
134	Moser Industries	OH		X	3			X			$1,000			1
135	Southeastern H. T.	NC	X		2	X					$3,000			11
136	Akron Steel Treating	OH	X		3		X				$1,500			2
137	Winston Heat Treat	OH	X		1		X				$500			9
138	Moog Controls	NY		X	4			X	X		$1,500			4
139	Elyria Spring	OH		X	3	X		X	X		$10,000			77
140	Mike Drain, Attorney	OH		X	1	X					$10,000			1
141	Cal-Doran	CA		X	1	X					$1,000			1
142	Conforma Clad	IN	X		1		X				$1,500			3
143	Southeastern H.T.	NC	X		2	X					$2,500			5
144	Hyper-Tool	OH		X	5				X		$2,500			1
145	Wolliston Alloy	MA		X	4			X	X		$1,500			14

HOTLINE SUMMARY REPORT
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HOTLINE NUMBER	HOTLINE CALLER	STATE	MEMBER	NON-MEMBER	# OF COMPANIES INVOLVED	TECHNICAL	INFORMATIONAL	MEMBER REFERRAL	NON-MEMBER REFERRAL	SPECIAL PROJECT	ECONOMIC IMPACT	SURVEY RECEIVED	VERIFICATION RECEIVED	TIME TO COMPLETE (Calendar Days)
146	Universal Metal	OH	X		4	X		X			$10,000			1
147	API	MI		X	3	X	X				$5,000			80
148	Aluminum Waste	OH		X	3	X			X		$40,000			13
149	Boeing	KS		X	4	X					$10,000			26
150	L & L Associates	MI		X	2				X		$25,000			19
151	Thermax	CAN		X	4				X		$1,000			1
152	Steel Products	OH		X	1		X				$10,000			4
153	Tridon	TN		X	1		X				$5,000			2
154	TRW	OH		X	3			X	X		$50,000			1
155	General Electric	NY		X	4		X				$1,000			3
156	Avialo, Inc.	TX		X	3	X	X		X		$50,000			70
157	Mfg.'s Resource Ctr.	PA		X	3	X		X			$10,000			3
158	Snap-On Tool	WS		X	1	X					$5,000			8
159	Atlantic Tool	MI		X	2			X			$10,000			1
160	Argo-Tech	OH	X		1	X					$2,500			3
161	Cauldwell	NY		X	1	X					$5,000			4
162	Luk, Inc.	OH		X	3		X				$0			2
163	Southeastern H.T.	NC	X		1	X					$5,000			24
164	Golden State Engineer.	CA		X	1	X					$500			6
165	Southeastern H. T.	NC	X		1		X				$500			1
166	Southeastern H. T.	NC	X		1	X					$500			3
167	Alcoa	IN		X	3	X	X		X		$2,500			21
168	Modern Industries	PA		X	1		X				$500			1
169	Conforma Clad	IN	X		2		X				$10,000			18
170	Akron Steel Treating	OH	X		2	X			X		$500			8
171	Olympic Steel	OH		X	4			X	X		$10,000			8
172	Brydet Development	OH		X	2			X			$500			1
173	National Steel & Rule	NJ		X	3		X	X	X		$80,000			1

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174	Drop Dye & Forge	OH		X	5	X		X	X		$150,000			42
175	Arkansas State Univ.	AR		X	2		X		X		$500			1
176	Sisco	OH		X	2			X			$20,000			3
177	Climax Metal	OH		X	5			X			$10,000			1
178	Alpha Heat Treating	PA		X	1	X					$10,000			1
179	Thermal Treatment Ctr.	OH	X		2	X					$500			1
180	Nippondenso Tenn. Inc.	TN		X	3		X		X		$1,000			2
181	American Heat Treating	OH	X		1		X				$1,000			2
182	Kolene	MI		X	3		X				$500			1
183	Teledyne	IN		X	3				X		$1,500			1
184	Stahl Specialties	MO		X	2		X				$1,000			3
185	Deformation Control	OH	X		2		X		X		$185,000			14
186	Cooper Industries	TX		X	1	X					$1,000			2
187	Weiss Industries	OH		X	2	X					$3,500			6
188	American Heat Treating	OH	X		3			X	X		$1,500			8
189	Technical Sales Assoc.	MI		X	4			X	X		$480,000			3
190	Southeastern H. T.	NC	X		1	X					$10,000			1
191	Consolidated Engineer.	GA		X	2				X		$50,000			3
192	Naval Aviation Dep.	CA		X	2	X					$10,000			4
193	Air Fasco Industries	OH		X	2				X		$500			1
194	Donati Machine	PA		X	1	X	X				$1,000			2
195	Raytheon	MA		X	2	X	X				$500			22
196	Service Heat Treating	WS	X		1		X				$500			1
197	Haliburton Eng.	OK		X	1	X					$1,000			1
198	Bearings Services	PA		X	4			X			$10,000			1
199	Component Repair	OH		X	1	X	X				$1,000			2
200	H & H Machine	OH		X	4			X			$500			2
201	Southeastern H . T.	NC	X		3	X					$2,500			14

HEAT TREATING NETWORK

HOTLINE SUMMARY REPORT

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HOTLINE NUMBER	HOTLINE CALLER	STATE	MEMBER	NON-MEMBER	# OF COMPANIES INVOLVED	TECHNICAL	INFORMATIONAL	MEMBER REFERRAL	NON-MEMBER REFERRAL	SPECIAL PROJECT	ECONOMIC IMPACT	SURVEY RECEIVED	VERIFICATION RECEIVED	TIME TO COMPLETE (Calendar Days)
202	Southeastern H . T.	NC	X		4		X		X		$10,000			14
203	Southeastern H. T.	NC	X		1	X					$5,000			5
204	J & M Manufacturing	KY		X	1		X		X		$20,000			6
205	Conforma Clad	IN	X		1		X				$500			2
206	AGA Gas	OH	X		2			X	X		$5,000			2
207	Harris-Thomas Drop Frg.	OH		X	4			X			$90,000			3
208	Edison Welding	OH		X	2			X			$500			1
209	Visovious	OH		X	3	X		X			$10,000			4
210	Conforma Clad	IN	X		6				X		$10,000			4
211	American H. T.	OH	X		1	X	X				$1,000			3
212	Meca Electronics	NJ		X	1	X	X				$10,000			7
213	Milwukee Elec Tools	WS		X	1	X	X				$2,500			105
214	American Koyo	OH		X	2			X			$100,000			3
215	Iberia Fabricators	OH		X	4			X	X		$5,000			2
216	ZIRCONIA	OH		X	3				X		$500			1
217	Braddock H. T.	NJ		X	1	X	X				$2,500			1
218	Corning Inc.	NY		X	2	X	X				$500			1
219	HTC Inc	NY		X	2				X		$1,500			2
220	DEMAG-DELAVAL	NJ		X	3		X				$500			22
221	Cincinnati Steel Treating	OH	X		3	X	X				$500			10
222	Trinity College	CT		X	1	X	X				$15,000			62
223	Norweld Stress	CAN		X	1	X	X				$0			24
224	Phase-a-matic	CA		X	2	X			X		$1,000			3
225	National Extrusion	OH		X	3	X			X		$1,000			1
226	Dell Steel	DE		X	1	X					$0			
227	Nutralite	CA		X	2				X		$6,000			2
228	Hyden Precision	NY		X	3			X			$2,500			1
229	DEMAG-DELAVAL	NJ		X	5		X		X		$500			1

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230	Diamond Tool	OH		X	4			X	X		$1,250			1
231	BATTELLE Inst.	OH		X	5			X			$1,000			1
232	Southeastern H.T.	NC	X		1		X				$500			6
233	Perfection In Carb	OH		X	5			X	X		$1,500			6
234	Southeastern H.T.	NC	X		1	X					$500			3
235	Southeastern H.T.	NC	X		1	X					$1,000			27
236	Atmosphere Processing	MI	X		1		X				$1,500			6
237	Cincinnati Steel Treating	OH	X		1		X				$1,500			30
238	American H.T.	OH	X		1		X				$5,000			1
239	TEMPIL	NJ		X	2		X				$1,500		X	24
240	ARMA Tech.	CAN		X	1		X				$0		X	21
241	Southeastern H.T.	NC	X		1		X		X		$1,500			7
242	CENTERIOR	OH		X	1		X				$500			1
243	Confroma Clad	IN	X		2		X		X		$1,200			12
244	Clev. Wood Products	OH		X	1	X	X				$2,500		X	13
245	ALMCO	IN		X	3				X		$50,000		X	12
246	Southeastern H.T.	NC	X		1	X					$500			3
247	AMUNEAL Mfg.	PA		X	2				X		$50,000	X	X	9
248	INFAC/IIT	IL	X		2			X			$2,500			5
249	L&S Tools	IA		X	5		X		X		$50,000			3
250	General Dynamics	MI		X	2			X			$2,500			1
251	CENTERIOR	OH		X	1		X				$500	X	X	9
252	MECA Elec.	NJ		X	1	X					$1,000	X	X	2
253	Dan Lake	OH		X	1			X			$100			1
254	NAVISTAR	IL		X									X	
255	J.B. Steel	OH		X	5			X			$150,000			12
256	RIVNUT Eng.	IN		X	6				X		$7,500	X		1
257	Bowen Mach.	OH		X	3			X	X		$500			1

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258	Canton Drop Forge	OH		X	3	X	X		X		$35,000			12
259	Cardinal Fastner	OH		X	2			X			$225,000			22
260	Hitchner Mfg.	NH		X	2			X			$7,500		X	4
261	Elyria Spring	OH		X	3			X	X		$15,000		X	1
262	Southeastern H. T.	NC	X		3	X					$500		X	2
263	Valley H. T.	MO		X	2	X					$7,500		X	2
264	DASPIT	LA		X	2	X	X	X			$2,500		X	13
265	Nucor Bearing	NC		X	1	X					$12,000		X	10
266	Lowen Mfg.	ND		X	3		X		X		$250			2
267	Southeastern H. T.	NC	X		1	X					$500			1
268	Loral Defense	OH		X	2			X			$500		X	4
269	PRAXAIR	PA		X	1		X				$500			3
270	David Brown Ltd.	ENG		X										
271	EMTEC	OH	X											
154	**TOTALS**		**45**	**109**	**341**	**60**	**62**	**40**	**47**	**0**	**$2,373,800**	**4**	**15**	**1,621**

APPENDIX I

HOTLINE PERFORMANCE SUMMARY

HEAT TREATING NETWORK
HOTLINE PERFORMANCE SUMMARY
July 1994 - September 1995

OVERALL TOTALS

Hotline Calls Received	154
Member Calls	45
Non-Member Calls	109
Companies Involved	341
Technical Calls	60
Informational Calls	62
Member Referral Calls	40
Non-Member Referral Calls	47
Special Project Calls	0
Survey Forms Received	4
Verification Forms Received	15
Economic Impact	$2,373,800

AVERAGE LENGTH OF TURN-AROUND CYCLE	**Calendar Days**
Average Days to Complete a Hotline Call	10.5
Average Days to Complete Technical Calls	18.1
Average Days to Complete Informational Calls	13.2
Average Days to Complete Member Referral Calls	7.0
Average Days to Complete Non-Member Referral Calls	9.4
Average Days to Complete Non-Technical Member Ref.	4.2
Average Days to Complete Non Technical Non-Member Ref.	6.5

LONGEST/SHORTEST TURN-AROUND FOR EACH CATEGORY

	(CALENDAR DAYS) LONGEST	SHORTEST
Technical	180	1
Informational	105	1
Technical Member Referral	77	1
Technical Non-Member Referral	77	1
Non-Technical Member Referral	22	1
Non Technical Non-Member Referral	19	1

HEAT TREATING NETWORK
HOTLINE PERFORMANCE SUMMARY
July 1994 - September 1995

GEOGRAPHICAL BREAKDOWN

Hotline Calls Received	154
Total Number of States HOTLINE Calls Received From	25

Arkansas	1
California	5
Connecticut	1
Delaware	1
Georgia	2
Illinois	2
Indiana	10
Iowa	1
Kansas	1
Kentucky	1
Louisiana	1
Massachusetts	2
Michigan	8
Missouri	2
New Hampshire	1
New Jersey	6
New York	6
North Carolina	18
North Dakota	1
Ohio	59
Oklahoma	1
Pennsylvania	11
Tennessee	2
Texas	2
Wisconsin	5

Total Number of Countries HOTLINE Calls Received From	2

Canada	3
England	1